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FACTORS IN LIFE

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FACTORS IN LIFE.

THREE LECTURES

ON

HEALTH—FOOD—EDUCATION.

BY

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PUBLISHED UNDER THE DIRECTION OF THE COMMITTEE
OF GENERAL LITERATURE AND EDUCATION APPOINTED BY THE
SOCIETY FOR PROMOTING CHRISTIAN KNOWLEDGE.

LONDON:
SOCIETY FOR PROMOTING CHRISTIAN KNOWLEDGE,
NORTHUMBERLAND AVENUE, CHARING CROSS, W.C.;
43, QUEEN VICTORIA STREET, E.C.
BRIGHTON: 135, NORTH STREET.
NEW YORK: E. & J. B. YOUNG AND CO.

1672. e. 55.

THESE LECTURES WERE GIVEN TO THE WORKING MEN'S INSTITUTE, SEVENOAKS, IN 1884.

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FACTORS IN LIFE.

HEALTH.

HEALTH is the condition of life in which the body produces more energy than is lost in performing our work. This energy is partly inherited, and manifests itself in growth like that which changes a seed into a tree; it is partly the force imparted by food and conditions of existence, such as makes the difference between the stunted plant which only lives, and one whose ample branches are laden with heavier crops of fruit as years roll on; and it is partly the gift which mind makes to body as when the realization of new truth or beauty endows existence with a vitality which wins force from the successive incidents of life. It is the overflow of this energy that makes the fountain of happiness; so that happiness, when resting on a basis broad as life, comes to be the best measure for health. When health is augmenting, and every year helps us to revel in its joys more freely, it is hard for youth to believe that happiness will vanish if energy is lost at a more rapid rate than it can be renewed; yet the springs of health are then dried up as surely as the summer heat dries up the village brook which in winter seemed perennial. It is natural to feel this intoxication of health, and, as our associates are always not unlike ourselves in age, the eye of the young man experiences the unconscious flattery of remarking chiefly people of hopeful years as predominating in the world, and grows less observant of the freshness and glory of years left behind, and less interested in the feebleness and decrepitude that is to come. But although the body at last may work more slowly, and the mind cease with age to grapple with problems which once brought delight, and the energy of life manifestly decline, still, if we spend less of it than we receive, there is health to the last. But if we would drain the cup of happiness all through life, we must learn that health takes new forms with succeeding years; for when it is not lost, it for a long time gains in vigour. The bodily growth is complete long before the bodily strength is mature; the bodily powers begin to decline before the mental powers reach their maximum; and mental activity somewhat diminishes before the judgment is fully matured. So that when energy can be actively exhibited in one only of its phases, productive work diminishes long before life runs out, and the happiness which comes from labour passes away; while for those whose work can vary with the successive phases of their strength, enjoyment of existence need never cease. This is perfect, life-long health.

The inheritance of health with which we come into the world cannot be over-estimated. A number of persons, it is true, are born with defects of body or brain, just as some are blessed with corresponding advantages; but of disease the inheritance is probably comparatively small, and what is commonly regarded as an evil inheritance is much better explained as a consequence of life being continued under the same evil conditions as induced disease in the parent. This is strongly evidenced by the health remaining good till the arrival of one of the great epochs of bodily or mental change. For in childhood and youth, the fund of health, manifested in daily increase of power, is greater than we require; it seems inexhaustible. It is the energy of the human race unfolding itself—as with a luxuriance of tropical verdure—faster than the new-grown tissues can learn to prove its use. This rapid change of bodily tissue, beyond doubt, has its weak aspect in want of stamina, which exposes the young body to many possible disorders and infectious diseases, from which the health would hardly rally, were it not reinforced by ever-new expansion of the life which is growing. But these disorders and diseases are more or less within our own control; and, so far from being necessary ailments incidental to youth, which parents should be glad to have over and done with, are evils which often undermine health through all succeeding life, from which we should shield the young as we would protect them from the storm or savage beasts. If this inherited health is a definite fixed quantity, which under favourable circumstances would carry its possessor through life to old age, then it is evident that when the vitality is used up in encountering attacks of measles, whooping-cough, fevers, and their kindred, not to mention yearly coughs and colds, there is less chance of old age being reached, or of the health being sufficient to escape disease in manhood. Guarded from such evils, the inherited health, which enriches existence beyond earthly treasure, is capable under wise management of securing to man nearly a hundred years of enjoyment. The circumstances of existence, however, are not always favourable to health, and the wise management of life is hard to learn.

We may not be able entirely to overcome hurtful influences of climate and soil, but every human being can take up arms against customs which are prejudicial to health, and conform to conditions under which the parts of the body work together for their common good. Ignorance of its conditions is the main obstacle to health.

Every one knows that plants and animals are influenced by soil, but we do not always apply this knowledge to man. The potato is most free from disease on dry sandy soils, because the water drains away which is necessary for the growth of the fungus which attacks that tuber. But a wet soil may be favourable for root crops which are not liable to disease of this kind; and the best crops of turnips, mangolds, and the like, grow where the subsoil is clay. Then again, the same kind of crop can rarely be grown profitably for many years in succession on the same land, because various enemies learn in time to attack it. It is just as necessary for successive generations of men to change their habitations, and to escape from conditions favourable to disease; but in making the change it is unpardonable to neglect the influence of the geological structure of the country on man, while it is turned to account in growing a sheep or a potato. Take, for example, the distribution through Britain of any disease affecting man, and it will be found influenced in area or intensity by the soil. If I instance consumption (phthisis), it is because we know that consumption, if not caused, is at least characterized by the growth within the lungs of a lowly microscopic form of life which can be collected and easily recognized. Now, when the distribution of the disease is recorded upon a geological map, with the relative intensity of its ravages, the regions which suffer most are found to be those covered by the wet soil of impervious strata; while even here, the death-rate declines as the land is drained. Therefore we may say that the *Bacillus* organism finds conditions favourable for its development in the moist and cold air which such a soil ensures. But when we turn to the sands, sandstones, and porous limestones, they are free from the disease in proportion to their elevation above the sea and perfect natural drainage. Nowhere is this more strikingly seen than in the south-east of England, the lands of the clays of Norfolk, Suffolk, and Essex having a heavy death-rate from phthisis, which disappears when those rocks are covered with newer sands and gravels. But with other diseases the distribution is different; and geological formations which are most conducive to consumption are remarkably exempt from heart-disease, as is shown by comparative freedom from this class of disease in Wales and the counties of Norfolk and Suffolk. This knowledge, however, can guide the movements of the mass of the people only when the elements of geology are taught as a compulsory subject in every school, and when the intelligence of the nation requires the Government Departments to collect all statistics concerning the people in districts which are defined by geological conditions of the surface of the country, and provides for the co-ordination of knowledge which affects the health and well-being of the nation.

Conditions of climate cannot be neglected by any one who would enjoy health. The influence of summer heat is an endowment of external energy to men which in winter has to be compensated by other means. Its manifold effects in nature are seen in the formation of foliage, wood, and fruit, and in the increase of life of every kind. If we live in the old-fashioned way, fitted to encounter the mean temperature of spring and autumn, then, for health to be preserved, food, clothing, and exercise must be adapted successively to the seasons of greater heat and greater cold; for, if the food remains the same, our weight increases with the heat of summer, and declines with winter cold. But the chief difficulty with climate is to ensure that the health-giving, oxidizing influence of sunshine should penetrate into the house, and to shield the body against the effects of extreme daily variations of temperature and treacherous cold winds in a clear sunny sky. Here is the source of many minor ailments, for the alteration of temperature changes the work of the organs of the body. By stopping evaporation, it transfers the work of the skin to the lungs, and modifies the work of the digestive and internal organs in ways inconsistent with perfect health. The lungs may be protected by keeping the mouth closed; but it needs a higher estimate of the value of health than is yet common, to pay this price for freedom from colds. And prevalent cold winds, by carrying away heat from exposed parts of the body, may produce rheumatism and many inflammatory conditions of vital organs; which can only be resisted, when their cause is known, by protection with a natural cold-weather covering of fat, which food may furnish, or by its less efficient substitutes in garments which prevent loss of heat. But while such changes of temperature are inconvenient, they are a condition of health in ensuring constant renewal of the air we breathe, and ceaseless removal of the noisome products of existence, which contaminate the atmosphere. It should never be forgotten that children require relatively more air than adults, the number of respirations to a minute being 44 in the new-born infant, 26 in the child for the first five years, 16 in the man of twenty-five to thirty, and 18 in the man of thirty to fifty. And therefore, from his slower respiration, a man is better able to escape the effects of cold air than a child. Thus when the air has a temperature of 68° F., the temperature of the air expired is 99·5° F.; but if the temperature of the atmosphere sinks to 20° F., the expired air falls in temperature to 85° F.; and therefore the heat of the body lost by the work of raising the temperature of air breathed is in proportion to the lowness of temperature and rapidity of respiration, and that loss can only be made good by food. If the necessary supply of fresh air is diminished from indoor life, or ignorance of the necessity of ventilation, respiration becomes deeper and more frequent, and the nerves and tissues are exhausted and enfeebled with the labour thrown upon them, so that in time the health is lost. Free circulation of air through the house to oxidize and remove impurities is not less necessary than unrestricted passage of air through the lungs.

The air is rarely saturated with water, and its dryness favours evaporation from the skin, by which the surface temperature of the body is lowered and kept cool. Like the lungs, the skin should always be parting with water and carbonic acid. This loss results from minute coiled glands being embedded in the deeper part of the skin, where each is surrounded with a network of the finest terminal ends of blood-vessels termed capillaries; and from the blood contained in them each gland separates the thin fluid and salts which, when poured upon the surface of the skin from the outlet of the gland, is known as perspiration. In minute quantities, it contains numerous impurities. And then, the skin of the whole body is covered with hairs, which are nourished by fatty secretions, poured out about the hairs, from glands termed sebaceous glands, which add many fatty acids to the alkaline fluid from the sweat-glands. Now, as there are about two per cent. of solids in the perspiration, it follows that after the atmosphere has carried away as much as can be evaporated, there will remain a deposit upon the skin like a crust, increasing in thickness all day long. But this is not all, for the epidermis is the outer layer of the skin, which contains no blood-vessels; the cells of which it consists are ceaselessly renewed from beneath, and, as they reach the surface, become flatter and drier by evaporation of their fluid contents, until they fall apart, and would envelop the body in a cloud of scales of dead organic matter if it were not for the action of the perspiration and fatty excretions in matting them into a paste, which clings to the living skin. It is a first requisite for health that this excretion should be removed. If the local government provides scavengers to remove the waste matter which is produced in the streets, and dust-contractors to carry away the waste matter produced in the house, it is more urgently necessary that every one should remove the malodorous dirt from the skin, the chosen breeding-ground for the germs of disease, which are always wafted in the air and ready to settle down and develop into pestilence. Local government boards should never sanction the use of any building as a habitation in which there is not a bath with ample water-supply. But the want of these conveniences has made the mass of the people tolerant of this defilement of the skin, which among the poor goes without cleansing for days, or sometimes for weeks or even months, to the destruction of their own health, and to the common danger. If the skin is not efficiently washed and rubbed daily, the least that can happen is that much of the work which it should perform is thrown upon the lungs and the kidneys. But those organs have work enough to do already, and by doing extra work they become enfeebled and disordered. The person with an unclean skin must expect to suffer from colds and coughs, and to sink into feeble health and inactive life as the organic poisons become stored within the body; while the scourge of fever will from time to time come as a reminder that the mischief of dirt is not past remedy. It is some help, no doubt, to wash the hands and face whenever food is taken, for this removes the visible poisons which may have settled upon the skin from without. And this habit of ablution, ordained as a religious duty by the Mohammedan faith, is worthy of imitation by all men, for it is the germ of all habits of cleanliness, which extend from small beginnings till they permeate life. The difficulty of securing the universal practice of such habits is chiefly a matter of expense. There are few pleasures more costly than perfect cleanliness, since it implies labour in its every detail. And such labour is never satisfactory in any rank of life unless the wife can direct and take part in it, because servants in no other way can become of the "same flesh and blood" as their employers. Personal cleanliness, to be of any value, must extend to all members of a household. It is as important for servants as for the mistress. They are often exposed to greater chances of infection, and have greater capacity for diffusing disease. If the cook and her kitchen are not scrupulously clean, the health of the household suffers with every touch given to food; and many an obscure derangement of health, which baffles medical skill, is due to this poison of dirt.

Difficulties in the way of household cleanliness are often caused by the method of building houses in towns, as well as by the increased labour which results from difficulties in obtaining a water-supply on the several floors. And there is reason to think that in the process of domestic washing of linen far too little water is commonly used for purposes of health. We are too tolerant of dirt, when the quantity is not very obtrusive. We endure deficient water-supply, which is inconsistent with cleanliness, and yet protest that cleanliness is next to godliness.

Facilities for bathing are not sufficiently general. They exist in rivers, but the proportion of people who can thus bathe is small. The empire of pagan Rome built beautiful baths all over Britain, whose remains still attest that we cannot compare with them in cleanliness; and although Britain is not entirely without public baths in towns which stand on the sites of the Roman buildings, the nation as a whole has not emerged from the Teutonic ignorance of what water can do for health and social amelioration. We begin life with the symbol of purification by washing, in baptism, but it remains little more than a symbol unless we can wash away the dirt and impurities which daily life engenders, and win the invigoration and strength which are the rewards of cleanliness and the foundation of the moral sense of purity.

The wisdom of the State never permitted any greater obstacle to come between the people and their health than the monopoly of water-supply by companies, who make it an article of trade. It may be difficult for corporations to supply large towns with water at a nominal profit, but no undertaking in the interest of health is more worthy of the support of every inhabitant of a town. The water might then be softened more perfectly than is at present the case, and its freedom from organic impurities placed beyond suspicion. Water-companies have done good service in making the growth of towns possible, and in furnishing the material for many industries, but they owe duties to the community, and especially to the poor, in relation to health; and so long as they anywhere make extra charges for baths and sanitary conveniences, not to mention charges for patches of garden which help to purify the air, their management is inconsistent with the health of the community, and they may justly be held to contribute, to the best of their ability, to the spread of disease by putting a penalty on cleanliness.

Rain may help to wash away the germs of disease from the outside of the house, but we can never rest content till the house is easily purified from within. Disinfectants are but a poor substitute, in most cases, for water; yet, where the water is not to be had, we must be content to secure the aid of carbolic acid to prevent organic poisons from diffusing, and be thankful for medical help to stop the ravages of disease, when it lifts its head through the surrounding dirt.

Looked at merely from the commercial point of view, there is nothing so unprofitable as the failure of health termed disease. The expense of medical advice in recovery is the smallest part of the cost. We know that it involves the loss of days and weeks of life, and loss of productive work to ourselves and others; but it also involves a debilitation of body and loss of nervous strength, which endure after it is gone. It would, therefore, be more prudent and more profitable if it were the recognized function of doctors to keep us in health rather than help us out of sickness. In some parts of China medical men are thus employed to keep their patients in health. If every household were systematically visited by the medical man, and the services of the doctor retained by each family so as to be always at command, the severity of many diseases would be mitigated, and they would rarely obtain the prevalence which now exists. Probably nothing stands in the way of such prudence but the cost.

The cost of medical advice, however, is in proportion to the time consumed; and any one who reflects that in a single morning a large number of out-patients may be adequately prescribed for by a single physician in a hospital, must realize that tedious statements and conversations which commonly consume a doctor's time in private practice add to the cost of his advice. In some Continental cities the medical man confines himself as strictly to business in private practice as in his hospital practice. His visits last but a few minutes, and his fees are only a fraction of those necessary in this country. It is probable that if a town were divided into medical districts, each with a population of say nine thousand to a medical man, a fee of a few shillings to a pound or so, paid for each individual, on the basis of the relative value of houses, would suffice to secure the best medical advice throughout the year, and yet provide good incomes for the doctors. This plan would be little more than the application to the community generally of the principle of sick-clubs and benefit societies, such as are organized by the working classes, or the supervision of the health of a large school or the army by the resident medical officer. But its adoption would imply more thrift and greater regard for health than is yet characteristic of our countrymen. In nothing is the spirit of gambling more prevalent than in regard to health. A man recklessly throws for the chance of health, though he knows that there are ninety-five blanks in every hundred casts of the die; but the wise man will care for his health as he cares for his business, and leave nothing to chance which can be secured by foresight.

If these external circumstances of earth, air, and water often modify health in ways beyond our control, there are many other circumstances in which, by exercise, activity, variety, regularity, temperance, and self-denial, we may keep the bodily health more perfectly under control. First in importance among these controllable conditions must be placed bodily activity. The body exists to work. The external movements, which gradually decline from the rampant vigour of childhood to the cautious movements of age, are but the necessary correlative of changes in the unseen work of our vital organs. The whole internal machinery knows no rest night or day, and labours incessantly while life lasts. The heart, the lungs, the countless glands labour always, and do what they can to form, repair, and invigorate each living being, directed by the stimulus of the nerve-centres, which act independently of the brain, and give the individual no occasion to take thought for their nutrition. This unconsidered internal toil probably exceeds in amount of labour the utmost work that we can accomplish when roused to the full manifestation of voluntary effort. It is, however, incapable of maintaining the body in health unless supplemented by the exercise of muscle and nerve in some form of daily work. There is not an involuntary vital action that is not made more energetic by voluntary bodily labour. Thus stimulated, the heart drives the stream of blood faster through the structures which it feeds; the lungs pour out from the blood larger volumes of the carbonic acid poison, which, when retained in the body, deadens the activity of every organ; and every part of the body, purified by the increased action of the external and internal glands, gains in power.

Activity is the condition of all growth, because exertion brings to the several parts of the body the nutrient substance of the blood, from which each takes up its tissue, at a rate which is most rapid in places where most work is done. In respect to its nutrition, each part of the body, such as fat, muscle, nerve, bone, stands to the whole body in the position of an excreted substance. The essential difference of bodily structures from each other is a difference in chemical composition. What we term their nutrition is no more than the action of their covering membranes in separating the substances of the several tissues from the blood. The sheath of a nerve separates nerve substance; the covering of muscular fibres separates muscle substance; and the covering of bones forms bone substance. Muscles, nerves, bones, and blood-vessels, in growth, all undergo a simultaneous increase. This depends partly on the action of the enveloping membranes mentioned, and partly on the condition of the blood. So that, if there is too little exercise, muscles, bones, and nerves may come to be enfeebled by being underfed or partly replaced by fat; while, if there is too much exercise, the bony substance may be formed too fast to permit of the full growth being attained. In its growing time especially the body is intolerant of all overwork, and if the exercise is prolonged till aches and pains utter Nature's protest against misusing the first great pleasure of existence, then the benefits which it might have given are withheld; growth is prematurely completed, or arrested in some part of the body; and the energy which should have slowly perfected the full stature, exhausted in special local efforts, produces dwarfed and ill-proportioned limbs. In youth the removal of substances from the body is less rapid than their accumulation, but it is quite possible for the supply of new material to become by overwork less rapid than its removal, so that when parts of the body undergo relative waste, while others experience increase, an infinite variety of shape and stature may result. This law of nutrition, which produces in different individuals of a human family recognizable varieties of form and endowment, is the same in kind, and only differs in degree from the processes which divide species of animals from each other. The stimulants to growth produced by muscular activity all resolve themselves into pressure upon or pulling of the several tissues; but, since growth is an increase which can only take place when the pressure is removed, it occurs in the brief intervals between the successive actions of pressure or tension. Pressure squeezes the blood out of a muscle more rapidly than it usually circulates, and the removal of pressure allows the blood from an artery to rush into the part with more force than usual. Therefore, the more the blood-food circulates through it, the covering membranes separate the substance of the tissue from the blood faster, and this increase is termed growth. Such development is conspicuously seen in the limbs of athletes and public dancers; but it takes place in a less degree in all persons with every part of the body which is used. We know the familiar description of "horny-handed sons of toil"; and know that, sensitive as the skin of the feet is in most persons, it thickens with use so as to form a protection in those who go barefooted.

This is the law of nature for the body and for its parts—that if it will not work, it shall be dwarfed and flabby and feeble; if it works to excess, it shall be deformed; and that perfect growth can only take place when the organs are allowed free play and trained in steady daily exercise. Therefore it is manifest that the proper and healthy development of the body, in so far as it depends on exercise, is a matter for physical education. If the toes are pinched and cramped they become disfigured by horny growths, which cannot bear the pressure of the boot; and then in walking the limb is only used as a prop, little better than a wooden leg, where the bones are steadied by the muscles, instead of becoming an organ of graceful motion, in which movement is made a delight because the work falls evenly on the whole of the muscles of the limb instead of on a few. We might have expected in these days, when machinery is used to make boots cheaply, that the best anatomical skill would have been secured in shaping the covering of the foot to the necessary forms, to give every one a firm elastic grip of the ground, bringing every toe into action, and making exercise the pleasure which it must become if enough walking is done to preserve health. But statistics of the forms of the human foot are not enough known to enforce a reform in its covering. Children are often permanently lamed before the foot is half grown, and no advantages of after life can overcome this defect of management; and it is impossible to estimate the aggregate loss of health and wealth to the nation which result from such disregard of the condition of activity in the matter of shoe-leather. But if the extremities are deformed and injured by the ill-shaped hard leather covering, the whole body, especially during its growth, is liable to become misshapen from the effects of improperly fitting garments. It is rare at any period of life for the chest to have ample room for its expansion; yet so rapid become the lung-movements at about the age of seventeen that new discs of bone for a time make their appearance at the extremities of the collar-bones, with which they afterwards blend; and unless the ribs are free to make the utmost expansion of the chest, the lungs can never do their full work. And unless the waist be as free from compression in women as in men, it is impossible that the vigour of digestion, and the nutrition which depends upon it, can be equal in both sexes. Modern science cannot improve on the wisdom of the ancient Greeks in their anxiety for physical development among the young, and can only endorse the lesson of the fable of the choice of Hercules, taught by Xenophon two thousand years ago, where Virtue tells us that if the body is not exercised laboriously, young men are impotent in body, old men senseless in mind; and, passing through youth without toil, old age becomes a burden.

With successive periods of national history the conditions for individual exercise are altered. The growth of many industries in the last fifty years has gathered the scattered village populations into towns, leaving the health-giving old English sports to extinction. The ever increasing use of machinery in place of hand labour, has taken millions of men from the open air into factories, and deprived them of the sources of muscular strength which their ancestors enjoyed, when strength and skill were necessary qualifications for the workman. But once more the old delight in physical labour is rising phœnix-like among us, and sedentary occupations, which in towns sap the vitality of so many, give place, when hours of relaxation come, to all kinds of voluntary toil, kindled by love of country, love of nature, and the noble sense of combined effort. The health of England will long feel the effects of volunteer drill, use of the tricycle, and the revival of cricket. Seeking these pure enjoyments, the young man finds not only pleasure in the passing days and the delight of happy memories, but the unexpected happiness of enduring health. If we would secure for our daughters or sisters the physical development which boys and young men now so happily command, we must help them to understand that health does not come without effort, even to women, and encourage them to share in the exercises which custom has given too largely to men. It is especially necessary for the young woman to remember that, just as the chief happiness of life is in labour, so the chief reward of labour is health. And perhaps the parable of the talents is here especially suggestive to those who have power to gain strength by taking exercise, and yet do not get it. It is worth remembering, too, that since the body acquires its best proportions and development only as the reward of labour wisely performed, it follows that if we willingly resign the labour to others, the birthright which was ours, of well-shaped limbs and comely proportions, becomes the inheritance of those who work for us. The domestic servant, whose chest is expanded by her work, and whose muscles are harmoniously trained, is often conspicuous for symmetry of growth and robust vigour, which are the envy of many a woman, who does not reflect that they are Nature's rewards for physical industry, which might be secured for her own children.

There is an exhilaration in activity and rapid movements which lies far deeper than the sense of triumph over the force of gravity, which tends to keep us stationary. The pleasure of skating, rowing, swimming, riding, running, dancing, military drill, field-games, and brisk walking is akin to the pleasures of artisans in their work, and is a physiological pleasure which rewards the exercise of every organ as it comes into action. Science may not yet be able to explain exactly how this pleasure is caused, or why the man who has walked a few miles experiences a nervous invigoration, which kindles a sensation of capacity for further effort. I am disposed to think his vigour results partly from the higher temperature which follows from chemical change consequent on our mechanical movements; and that it results partly from the structure of muscles, and the ways in which voluntary muscles and nerves are dependent on each other. The analogy between nerve-force and electricity has often been urged since the time of Galvani, but, seeing that nerve-force results from muscular exercise, we must examine for a moment into the structures on which this relation may be based. Nerves are delicate white threads, and by far the larger number originate among groups of muscular fibres, and become blended into larger trunks as they approach the spinal cord or the brain. Such nerves, as a rule, convey to the brain sensations from the muscular fibres, and return to the fibres commands to move, which are directed from the brain with an almost electric speed. If we examine under the microscope the structure of any muscle-fibre which can be controlled by the will, it is found to be a long strip, closely cross-barred like a ladder. It really consists of a pile of discs firmly united together, like a roll of alternating silver and bronze coins, contained in a thin transparent sheath. The dark bars, which correspond to the bronze, are found to be of a different substance and denser than the alternating light bars, which correspond to the silver. In miniature, it has the aspect of what is termed a voltaic pile. The celebrated philosopher Volta found that when two dissimilar substances are placed in contact, one of them always assumes the positive and the other the negative electrical condition. This theory led him to invent the voltaic pile, which consists of a column of discs of copper and zinc, separated by discs of cloth moistened with acid water. The pile produced a current of electricity. Subsequently dry piles were made out of brown paper rubbed with the oxide of manganese, and these too gave currents of electricity.

It is impossible not to recognize the resemblance in structure between such piles and a muscular fibre. We know that chemical changes which liberate carbonic acid, and probably lactic acid, are always going on, even when the muscle is at rest, and only differ in degree from those which occur when it contracts. Electric currents have been observed in muscles when they are at rest, but more strikingly when in action; therefore there seems little reason to doubt that a muscle is formed of a multitude of microscopic cells, making up in the aggregate an electric battery, which depends for its power on the changes which take place in the fibres when they contract. Electric currents are also found in the nerves. Hence I suggest that these nerves commence among the muscles, because they convey the electric stimulus which muscles generate, to the central nervous system. The stimulus is stopped just before it reaches the spinal cord, if the nerve is a spinal nerve, by a grey mass of nervous matter termed a ganglion—a sort of induction coil, which is to a nerve what a lymphatic gland is to the chyle—and this ganglion converts the electric stimulus into a nervous impulse, which, in its turn, may give rise to nervous force when it has been further changed by the batteries of ganglionic nerve-cells in the brain. In some such way muscular activity probably governs the invigoration of brain and nerve, and we may thus realize how great a factor exercise becomes in regulating health; for it is certain that it originates energy, which may be stored for years or for life in the brain without being finally given back in work, and is transmitted for many generations as a force quite as definite as a head of water, and capable of having its level raised in generations to come.

All discipline of body and mind is directed to securing the full manifestation of this power, for it is the force which carries us through life, and performs the work which falls to each man's or woman's share. It is sure to be squandered so long as we forget that the powers of nutrition and powers of exertion vary as life goes on. It is recklessly squandered, too, among the labouring classes by the influence of industries which are notoriously unhealthy; and, although these facts are well known to working men, who see their comrades drop away year by year, they do not learn or realize how much health is under their own control, or comprehend that they have no more right to introduce their children to industries which are fraught with disease than to expose them to infection. The workman is often exposed, according to the nature of his work, to breathing poisonous vapours or dust from metals, stone, earths, organic matter, and other injurious substances, or to the absorption of poisonous solutions of metals by the skin. Yet there is no objection raised by workmen to engaging in such pursuits; no overcrowding of the industries which are proved to be less injurious; but, on the contrary, such is the ignorance of the value of health and life, that the general desire of working men is to follow a trade in which remuneration of labour is high. This matter is chiefly in the hands of parents; and it needs to be sternly set forth that, if a boy is introduced into an unwholesome trade, he necessarily dies at an earlier age, or, to put the matter boldly, is devoted to death by his parents before the best powers of his life have developed. There is something due, too, from public opinion in helping to protect not only the young, but adult work-people, men and women alike, whose lives are shortened by the unwholesome conditions of closed shop windows and factory windows, where work is carried on in an atmosphere laden with foreign matter. There are many retail trades, like drapers, in which the air of the shop is nearly always bad, but capable of remedy by ventilation. This, however, is a small evil compared with the life of a potter breathing the dust of clay, the scythe-stone quarryman breathing underground the dust of sand, the coal-miner breathing coal-dust; or the tool-grinder breathing particles of steel. These and many other dangerous trades must be carried on, but if trade societies will not enforce the use of suitable respirators for artisans, it is surely a matter for the nation to deal with by an Act of Parliament, when the dust breathed is the dust of death. There is nothing heroic in thus seeking a grave, and it is difficult to distinguish between suicide and the voluntary pursuit of an industry which terminates prematurely a life that could be prolonged in useful work by the use of a respirator. And I am not sure that a moral distinction can be made between homicide and engaging men in a deadly industry by the bribe of bread, when the employer knows the early age at which his men die, and has the power to extract the sting of death from their work by preventative care.

The healthy employments conducive to long life are those in which a plentiful supply of fresh air is possible, with freedom from contaminating conditions. But though health and long life go with them, there is no competition to follow them in this country. Agricultural labour; all kinds of work in wood; making of musical instruments, paper, and leather; manufacture of brass, iron, and steel; shoemaking and baking,—are industries which tend to prolong life; and they teach how other industries may be made less injurious by purifying the air which the workmen breathe. With the organization which most trades possess, the remedy should not be long wanting; and when work-people seek to protect their own lives, and the health of their children, by improved sanitary conditions for labour, the heart of the nation will support their efforts.

The hours of labour have of late years been greatly shortened for the artisan, but I cannot help thinking that too mechanical a rule is followed in this matter. The effect of short hours of labour is necessarily to increase the cost of all manufactured goods, and make competition with foreign countries difficult. And since the strength of the workman varies at successive periods of life, so, I think, should his hours of work. If, for example, eight hours a day were the normal period for active labour, then in the years from twenty-five to forty a man might well work for ten hours. But old age needs protection not less than youth, if the labour of manhood, in the mean time, has to be done.

Health is largely dependent on variety; and a great deal of labour is so monotonous that the interval of Sunday, even if it only breaks the routine of labour, has a beneficent influence. And every opportunity should be secured, not only for breathing fresh air by exercise in parks or open spaces or on country roads, but for enjoying form and colour in nature, and variety of growth and habit in life. Holidays have well been called a holy institution, for they take us away from the shadowed side of the world, where monotony induces intellectual or moral somnolence, to spots where the sun shines, leaves glisten, and the eye in moments of relaxation drinks in the moral sustenance which nature offers in her beauty, calm, ceaseless work, and varied conditions.

There was a wise provision for health in the ancient institution of pilgrimages, ordained by the Roman Catholic Church, which ensured periodical exercise and fresh air for many under the comforting influences of faith. Most modern pilgrimages are little more than flittings to the seaside or the mountains, and mostly for the rich. Yet in the north of England, in many mills, money is saved for excursions, which carry the mill hands for a week or two to the sea or to foreign cities; and it is to be desired that this health-giving element of intellectual variety in life should extend, until the mass of the working people cease to feel the slavery of work in increased knowledge of the world in which they live. A few old habits of holiday-making still linger in odd corners of the country, though the days of gleaning, which gave a summer holiday in the fields for country women, are now ended by the thrift of gleaning machinery. But the fruit-harvest and hop-picking are still festivals in the south-east of England. In summer and autumn they bring whole families of labourers by hundreds from London alleys, to live for weeks or months in beautiful scenery, almost in the open air, to return better nourished and bronzed to face the winter in town.

Short intermissions of work, however, at regular intervals, like the Saturday and Wednesday half-holidays of schoolboys, or the evening closing in midweek at an early hour, which is common in country towns, is the form of variety most conducive to health.

We do not commonly consider the immense influence of regularity on life. The periods of circulation of the blood, and of respiration, vary but little. Almost every organ which has a periodic action can be trained to know the recurrence of the hour. The intervals at which food is taken, are often recognized to the minute; and it should be the aim of a wise management never to depart from this periodic and punctual habit of the body. The light even meals which are taken as a matter of routine are infinitely more conducive to health than the heavy meals which become necessary if the intervals between food are prolonged. It is the same with sleep, with work, and with all functions of the body. We have a store of strength to endure great strains, but they are met, as it were, by mortgages on health, and the man who lives long is usually he who lives with the regularity of a machine. Closely connected with regularity is the habit of temperance.

I know how impatient of control strength is apt to be, but the whole method of early life, in school work, games, and industries, is directed to its discipline; so that all efforts of body and mind should be performed not only without consciousness of strain, but with no more effort than is conducive to their health and vigour. In this way alone can the maximum strength be developed and preserved. The lesson has been taught for ages in the fable of the hare and the tortoise. It is the tortoise that wins the race, because his efforts do not produce the exhaustion which necessitates long periods of repose. There is no need to make the organs of the body run races as a method of work; and, looking at the effects, we might justly term such spasmodic exertion an idle habit, which results from a want of strength necessary for sustained effort. It is particularly necessary to remember that body and brain are always being renewed and restored; and therefore, if the loss of energy in work is not greater than the amount of energy which is restored, there is a sense of enjoyment produced by the work, which can practically be carried on as a pleasure, with very short intervals of relaxation. But when the limit of temperance is past, whether in the external work of manual industries, or in mental labour, or in the efforts thrown by food upon the internal organs, then we draw upon the inherited or stored-up strength for power to do the work. But this strength is life's capital, the daily interest of which only should be spent; and as the capital becomes exhausted, health gives place to disease, and life ends prematurely. It is impossible for the body to alter its construction, so as to rapidly renew the enormous waste of tissue which follows from prolonged efforts. Two hours is probably the limit of any mental effort that can be made as a matter of habit, and three hours the limit of bodily effort without intervals of rest; while food should be taken at every interval in work, in such quantity and of such kinds as stimulates to renewed effort. It is equally necessary to insist on temperance in relaxation. It is better to walk at three and a half miles an hour than five miles an hour. The young man may walk four miles an hour for thirty or forty miles a day without consciousness of exhaustion, but he does not get the invigoration which would follow if only half the distance were covered, because there is no leisure in which the stimulating influences of nature, among which he moves, can be observed and enjoyed. As we have already seen, muscular exercise stimulates the action of the brain, and, unless the bodily work is sufficiently temperate to permit of mental work being carried on at the same time, the health suffers. Illustrations of this invigoration from bodily labour are seen in the song which accompanies work in the Lancashire and Yorkshire mills, and in the interchange of ideas among the workmen which is found in most factories; and even when it does not thus find utterance, the efforts made in relaxation should produce an inward glow of enjoyment or a sense of peace.

The temptations to pass beyond what some may term the humdrum conditions of temperate life are often constitutional, and only to be met by mental conviction, which shall produce the moral effort of self-denial. One man may see early in life the necessity for relaxing work in old age, and begin the self-denial of thrifty savings which will enable him to face the time when it comes without fear; but for the mass of men there is need of self-denial in many ways, to preserve the health by which old age may be reached. But probably there is no consideration so important as self-denial in the matter of unsuitable food. The sense of taste needs to be trained as much as the body, to be brought under discipline and temperance, so as to refuse all strong flavours, if it is to act as our guardian in bodily health.

The varied activities of life which we have discussed can only be sustained by food, which renews the fabric of the body. And here especially the discipline of habit and the force of reason are imperatively called for to protect us from allurements of the senses and the enchantment of custom.

It is probable that to the average Englishman beef and beer symbolize the ideal of food, yet it is notorious that those who may be supposed to take these foods most freely—butchers and publicans—are among the more unhealthy classes of the community. Notwithstanding that the butcher's trade is carried on in the open air, and that there is no stinting of food, his trade is more unhealthy than that of the tailor with his sedentary work and confined occupation, less well remunerated.

I think the failure of health in the butcher is not so much due to unsanitary conditions of his trade as to the influence of excess of animal food. Nothing is more stimulating, and health under animal diet is only consistent with enormous bodily exertion in the open air; so that I believe the butcher is as much a victim to the exhaustion produced by animal stimulants as is the publican to the stimulant of alcohol. This may convey a lesson of the unsuitableness of a diet into which animal food enters largely, for those engaged in sedentary and inactive occupations; while the notable health of the agricultural labourer shows how much exertion may be performed on a diet which consists mainly of vegetable food. Nothing is more important than to adapt diet to the work which has to be done, and to avoid the flash in the pan of temporary stimulation to the nerves as a substitute for nutrition to tissues which are to labour. It is well known that there is a large class of diseases of nutrition, which are due to the introduction into the body as food of substances which cannot be got rid of by the work performed, and which, therefore, poison the blood, and disorder the organs which the blood supplies. Hence, the health is safer if the diet verges on underfeeding rather than overfeeding; but no law can be laid down, except that it is desirable that the actual mechanical work performed in each kind of industry should be scientifically determined, so as to be stated in figures, and that diets should then be framed for each industry, suited to the work performed, and the conditions in relation to air and exercise under which it is carried on. In no other way can any grand improvement in the national health be produced, or any great economy in the cost of food be effected. And it must never be forgotten that bodily work, in some form, is indispensable for the proper conversion of food into the substance of the body.

The diet must obviously change with the activities of childhood, youth, manhood, and old age. We know that milk is the food for babes, and that there is an insatiable desire for bread and butter in childhood; we are aware that universal custom interdicts the use of pepper and all spices and stimulants to youth, but leaves young people otherwise free to demonstrate the energy of digestive power with other food, jam-tarts, and pies, which for some inscrutable reason are usually prescribed in hospital dietaries for the insane. When the young ladies and gentlemen learn what happens to the said tarts and pies and uncooked fruit after they have been eaten, and how unwelcome and exhausting their presence is to the digestive organs, and how much buffeting they have to receive before any good can be got out of them, not to mention how unwilling they are to be got rid of, they may perhaps believe that some of the energy thus wasted would be acceptable later in life. The whole physiology of digestion consists in the conversion of starchy food into sugar by means of ferments, and the solution of other kinds of food by means of acids, so that both, becoming perfectly dissolved, may pass along with the finely divided fat through absorbing membranes into the body. And, though I own to having once had the youthful curiosity to try what physiological processes could do for many examples of the confectioner's skill, I assure my young friends that the experiment is not worth repeating. Milk, bread, and vegetable foods, with ripe fruit, are far better. Five meals a day are none too many in youth, while it should be a fundamental maxim never to go to bed hungry; with manhood the number of meals becomes reduced to four, and the foods taken vary in kind and quantity with the labour performed; while in old age there is usually less demand for food of all kinds, as the activity of the several organs, and of the body as a whole, becomes less. But if we take old age to begin at sixty, this is not a satisfactory condition; and the abstemiousness and failure of work which it implies can only be accounted for by too much labour having been thrown on the digestive organs in youth, or too much labour has been done by the muscles and nerves in manhood. The feebleness of sixty is the feebleness of bad management, and we should prefer to see old age commencing naturally at eighty; but this change will never be realized until people are trained in health, as they are trained in pursuits which health enables them to perform. The body is more than its labour, thought, or pleasure, as surely as the whole is greater than its parts; and until food is used to save the strength, instead of to waste it, it is used to little purpose.

One source of the exhaustion which food produces results from want of variety. Many a man tires of the alternation of beef and mutton, roast and boiled, and longs, perhaps, for giraffe or kangaroo; but he tires because the nerves are jaded with the intensity of the stimulus. No one ever tires of potatoes, or of bread, if it is made without fermentation; and half the weariness of eating is due to the food being exhausting through its intensity of flavour, and the other half to eating too much. For both of these evils the remedy is to fast, and one cannot too highly commend the dietetic wisdom of the Roman Catholic Church, in instituting fasts on Fridays and all the spring season of Lent. The fast is directed mainly to securing variety in food, with a view to healthier conditions of body and mind, and modern physiology would certainly suggest the wisdom of a return to the habit of abstaining from flesh at least once a week.

Closely connected with food is the use of physic, which may be regarded as a form of food, taken in homeopathic quantities with a view to making other foods more acceptable to the body. Spices are essentially medicines; brandy and spirits should be regarded in the same way, but, like all other medicines, are better avoided in health. If there is a tendency to substitute medicine for exercise, temperance, and regularity of life, the change is exhausting to strength and ruinous to health. It is better economy to pay a physician for advice which amounts to directions for careful cookery or proper ventilation than to pay the chemist for bottles or boxes of patent medicines, for it costs less money, and saves wear and tear to the digestive organs. Enfeebled digestion cannot be strengthened by the use of tonics, laxatives, pepsine, or acids; it rests with ourselves to remove the cause of the feebleness by temperance and regularity, and wisdom in the choice and preparation of foods, and to win back digestive vigour by suitable exercise. But in this disorder, as in all others, it is wise economy to form a habit of obtaining throughout life the best medical advice, at the earliest moment, when a suspicion exists that strength is failing; so that we may realize how prevention is better than cure, and regain vigour without knowing the loss of health.

The food consumed must always depend to some extent on the clothing worn, for, since one purpose of food is the production of heat, we shall clearly require less heat-producing food if the loss of heat from the body is partly arrested by clothes. Adaptation to temperature is very much a matter of habit. Mr. Darwin tells us, in the voyage of the *Beagle*, that the Fuegians, almost naked, sleep on the wet ground, and carry infants at the breast, unprotected from the sleet. But it is undesirable for civilized people to part with bodily heat which can be conserved. The idea of hardening or inuring young people to cold is physiologically unsound, and has a tendency to diminish the growth by loss of energy, unless the exposure is accompanied by a good deal of exercise and suitable food. On the other hand, it is important not to unduly raise the temperature of the habitation in cold weather, for the change in passing into the open air is then less easy to endure.

The human head is clothed by nature, but the customs of civilization have made the hair little more than an ornament. Hair is, however, an efficient protection against cold, and, by keeping the brain warm, quickens the cerebral circulation, and aids in intellectual work. It is, however, too frequently sacrificed by want of care. The hair needs nothing but brushing to be kept clean and healthy. The secretion of natural pomatum about its roots, when brushed on to it, gives the hair a gloss which cannot be equalled by any artificial application. Moreover, it protects the hair and maintains its vitality. Nothing is more prejudicial to the long life of hair than to wash this pomatum away, because washing necessitates the use of soap or some similar substance which injures the vitality of the hair and turns it prematurely grey. When the hair is well brushed, it is usually preserved throughout life.

One great object in wearing clothing is to maintain the temperature of the skin as nearly uniform as may be all the year round. The temperature of the blood is usually about 100° Fahr., declining a little with old age; but the temperature of the seasons varies fully 50° between summer and winter, so that, to arrest the loss of heat, the clothing must be more ample and of a more non-conducting kind in winter than in summer. At all periods it is important to have a warm absorbent woollen garment next the skin, because it will remove any excess of perspiration, and help to protect the body from chilling winds. Similarly, allowance must be made for the difference between indoor and outdoor temperatures, and this can only be done by movable garments, like shawls, comforters, and coats. Under all circumstances in nature, heat is lost more rapidly from pointed or uneven surfaces than from smoother surfaces, and hence the fingers become chilled to a greater degree than other parts of the body; and although it is often convenient to have the fingers free, it is desirable for the sake of health to clothe them in woollen gloves. Sometimes the extremities become chilled and affected with chilblains, but this can commonly be remedied by increasing the quantity of butter in the food, by which the temperature of the body is raised. All pressure of clothes on the body must be avoided, because it can not exist either over the chest or round the waist without interfering with respiration. Respiration is carried on partly by upward and downward movements of the ribs, partly by upward and downward movements of a great muscle termed the diaphragm, which stretches across the body below the lungs. If either of these muscular movements is diminished, the health begins to suffer; and it is difficult to control the diaphragm in this way by belts or girdles without squeezing the stomach, liver, and other vital organs, so as to incapacitate them for proper discharge of their daily work. The dress of men is, happily, less affected by the caprice of fashion than are the garments worn by women, and in the interests of health it were much to be desired that fashions were subject to medical approval before tradesmen were free to persuade customers that the comfortable shawl or cloak of a bygone season was now unsuitable or unbecoming. If the royal and noble personages whose customs in dress influence the habits of the nation could realize how every change they make will be imitated in a few months by millions of persons, regardless of its effect on health, and regardless of cost or the store of clothing in use, they might do something to protect the poorer women of England against changes, which are often vexations to body and mind even when they do not tend to deformity or disease. In times gone by, the Church too was not unmindful of the ways in which raiment influenced the well-being of the people; but, although we find clothing-clubs and Dorcas clubs still doing beneficent work under the direction of ministers of religion, the clergy do not now exert their legitimate influence in instructing the people against the mischief of high-heeled boots, or garments which leave the body insufficiently protected in winter, as in times gone by.

Habits of mind govern health more than might be at first thought supposed. The proverb "Laugh and grow fat" expresses the experience of mankind on the influence of cheerful temper upon nutrition; but, on the other hand, mental irritability is frequently an indication of imperfect nutrition, which results from overwork, or unwise choice of food. Every mother knows how her infant's health is governed by the calm of her own mind; and the anger or excitement which changes the quality of the milk with which the infant is fed equally affects the nutrition of her own body, for the change occurs first in the blood, out of which the milk is formed. No more impressive example than this could be adduced to enforce the necessity for holding the passions under control, if the health of the body is to be maintained; for it is not merely that the energy is withdrawn by mental excitement, which is necessary for the work of the digestive organs, but that, in consequence of the nervous excitement, they charge the blood with injurious substances; and when we consider that the very fact of giving way to excitement robs a man of the calmness and judgment by which alone he may hope to overcome or remove the cause of annoyance, it may be realized that want of discipline in the matter of temper is the worst possible, because most unproductive, expenditure of energy. Of course there are exceptional occasions when the expression of passion has a commanding force, and soldiers declare that this quality in a military leader has its influence on the field of battle; but in ordinary life success is the reward of calmness, which enables the body to be worked with the accuracy of a machine, even in its most extreme efforts. It is even more necessary to observe this regularity and temperance in mental conditions than in management of labour, food, and relaxation, because nervous exhaustion is more lasting in its effects, and more serious in its influence on the organs which it affects. I need not recall the unhappy consequences of brooding on ideas which we have not energy to take action upon so as to remove the cause of trouble, because daily life reminds us all how terrible is the retribution which nature exacts for this overwork or abnormal nutrition of parts of the brain, which robs life of enjoyment, generates melancholy, envy, hatred, malice, and all uncharitableness, even when it does not eventually carry the faculties beyond control.

And yet the perfect management of the mind is entirely a matter of habit, not to be perfected, it may be, in one year or two, or ten, but of life-long habit, which trains the faculties as they unfold, and as they vary their action; but it is a habit which can only be based upon bodily temperance, industry, and self-denial. If this should at first seem a hard path to follow, we are comforted by knowing that mankind has discovered no other way to old age and happiness, or to present health. Each individual knows the ways in which his peace and fulness of enjoyment may be found. Science has done something to demonstrate the reasonableness of ordinary efforts, but her teachings, like those of religion, commend us to habits which may be summed up in the principles of faith, hope, and charity with all men. The peacefulness of life which is thus to be found must be sought in all ways. For faith and hope to be the sustaining influences which human nature needs, there must be grounds for the confidence sufficiently strong to pervade life, and be inspiring and controlling influences in all its details. In all ages, in all lands, this need has found its expression in the sustaining and directing influence of religious life; and on this foundation, whatever may be its avouched form, the method of life which conserves health and strength may rest. But trust and hope are exhibited in many ways, for the laws of nature, which are the field of science, are a world of trust and hope. And in many ways scientific demonstrations and discoveries help to make the brief utterances of religious teachers more intelligible, and therefore more easy to follow. Laws of all kinds, even the changing statutes of our country, have their influence in giving a community confidence and peace, and remind us of the need for regularity and order in the details of life. But just as still waters run deep, so the peace of mind which we desire is an evidence of the force of life which has been acquired; and true repose has never been found in escaping timidly or fearfully from difficulties or troubles, or otherwise than in storing by daily effort nervous strength which will stand unmoved by the minor troubles of existence. This is the end of nutrition, of exercise, and of the pleasures which twine like garlands through the intervals of toil.

There is another source of health, which demonstrates the virtues of faith and hope familiarly, in the institution of marriage. Notwithstanding all trials, difficulties, and responsibilities which are incident to the married state, it is abundantly evident that marriage is conducive to health, and especially to long life. The reasons for this lie in the invigoration which affection imparts, giving a definite meaning and force to existence, which comes home in a more appreciable way to the individual than the other sustaining circumstances of life. The working man who, in his holiday, trudges into the country, carrying the child, knows what this means in a way that is unintelligible to the man who takes his holiday alone. But whether the majority of single men will seek the conditions of health which married life offers depends partly on the habits of self-denial and temperance which they have already formed, which marriage will in many ways exact and develop. But in seeking the mental and moral happiness which marriage can bestow, neither man nor woman in any condition of life has a right to disregard the necessities which it inevitably creates, for sharing the food, as well as the labour and pleasure of existence; and when, with increase of family among the poor, this subdivision of food has to be repeated many times, and with curtailment of attention to each child, then health is taxed beyond endurance, and marriage brings miseries, especially to the wife and children, from which both should be protected. It is in the care of many children that the health of a woman breaks down from overwork, more surely than that of the man from the increased labour of bread-winning; and the care which is necessary to preserve perfect health for the young life of a child must necessarily relax its vigilance when the duties of the day are too many to be properly performed. Therefore, in seeking to share life together, there are considerations of prudence, in regard to health in years to come, which cannot be ignored. The affection of the children may impart new vigour for a time, but there is a limit to the capacity of the bodily powers to respond to the increased work which it stimulates. On the whole, however, early marriages are economically preferable to late marriages, if only on the ground that the children are grown up and caring for themselves before old age comes upon the parents to diminish care for the children's welfare.

Finally, after all life's daily labours or pleasures are over there comes the need of rest, though why the sensation of tiredness exists no one can tell. We know that if a muscle is exerted continuously there is a limit to the time for which its contractions can be sustained, and if a nerve be stimulated it becomes after a time incapable of sensation. Whether it is that carbonic acid or some other product of work is produced in the tissue faster than it can be carried away does not admit of proof, though this is not improbable, seeing how similar the tiredness produced by the want of fresh air is to the tiredness induced by labour. Work long continued produces a condition of exhaustion which approximates towards paralysis, and this condition becomes absolute in sleep. The condition of sleep is most commonly induced through the eyes, ears, or the fifth nerve which spreads its branches under the skin of the face. If the facial nerve is over-stimulated by a continuance of the same sensation, such as exposure to a prevalent wind, or sitting before the fire, sleep follows; if the ear experiences a repetition of the same sound, as in a waterfall or monotonous reading, sleep is obtained; and if the eye is directed for long periods to the same class of objects, it similarly wearies. Under ordinary circumstances the blood circulates freely through the brain, which pulsates with the respiratory movements. Now, when any nerve-centre becomes incapable of transmitting its characteristic sensation, it ceases to be able to control the circulation of the blood in the brain, because the blood at once becomes deficient in that region; with this deficiency a condition of insensibility is produced, which interferes with the rapidity of the respiratory circulation; and, by sympathy, the other parts of the brain pass into a condition of insensibility, which lasts until enough oxygen has been absorbed into the blood by respiration to restore the wear and tear produced by the day's work. The effect of sleep is essentially to remove the stimulant of rapid circulation of the blood, which exhausted endurance. The number of hours of sleep required varies with temperament and with the kind of work done, but especially with the vigour of digestion. It varies, too, with the period of life, so that, while an infant passes much of its existence in sleep, and the child will sleep for ten or twelve hours, the man may only need from nine to six hours, and eventually be unable to take so much. This diminishing capacity for sleep in old age probably results from the lessened capacity for work, for there is no doubt that the individual needs rest in proportion to the severity of his labour. Sleep is life's restorative and most efficient comforter. Thus sleep knits up the ravelled sleeve of care; and day by day gives to the rested senses a new keenness of enjoyment, and to the invigorated body a new sense of health, which makes the turmoil of life grateful music. The action of sleep is in early years to bring the inherited energy into full power; in later years it makes the energy gained from bodily or mental habits a part of our existence. As an element in health, it is not less important than food. Sleep is at first, in infancy, the restorative from exhaustion which food produces; and as time goes on it removes exhaustion from every cause which molests health, and refreshes us with a vigour which neither food, nor work, nor pleasure can equal, and which these and all other incidents of our wakeful hours endeavour to sustain.

These considerations are the prime conditions of health. Briefly summarized, they amount to no more than the maxims which preachers and teachers of all ages have been thundering into the ears of an incredulous and unbelieving world; worked out in detail and applied in practice, they involve the best results of modern science. For us the great discovery of the conservation of energy—the discovery that when the forces of Nature seem to disappear, they only change their forms—goes for nothing, unless we turn it to account in augmenting the force of life; in vain does physiology demonstrate the functions of bodily organs, unless we apply that knowledge in discipline of body and mind. Strength and activity, the cardinal features in health, depend on the laws of physical force not less than on the laws of life. And as men herald the rustling of these scientific truths through the experiences of life, we shall see imbecility and disease—progenitors of pauperism and crime—fade away; and in their place should come a patriotic sense of duty to seek for health as though it were rubies, to be worn as the body's richest ornament, or laid out with wisest care in productive work, that it may shine before men in the light of happiness.

FOOD.

THERE is no subject which appeals more powerfully to the wants of mankind than the necessity for food; but among all communities there is an almost universal ignorance of the relative values of foods in building and sustaining the powers of body and mind. Most people consume the larger part of life in labour to obtain money wherewith food may be bought; and the wealth thus annually expended by civilized nations is equal to all other expenditures put together. In our own country the aggregate annual income of the entire British population is little more than £1,000,000,000; and the sum spent upon food is estimated to exceed £500,000,000. Yet in selecting food a scientific knowledge of the effects which different foods produce may be said to be disregarded; and our choice is influenced chiefly by inherited habit, by our knowledge of cookery, by individual preferences, by appeals which some foods make to the senses, but mainly by the relative abundance of foods in the markets. So that it is almost a matter of accident whether we are nourished or starved, invigorated or exhausted, fattened or kept healthy, by our food. This is partly a consequence of the changes of custom, occupation, and of food produce which successive ages have introduced; so that the food problem for ourselves is different from what it was for our ancestors, the old English breakfast of ale and steaks being almost as much an extinct institution as cakes and ale for supper. But it is partly a consequence of the necessity for varying the diet with successive periods of life, so that the habits of youth are no guide for maturity or old age, any more than food suitable for a country life would be found posible with the sedentary occupations of a town, or the food taken in laborious occupations would be consistent with health in those less actively employed; while bodily labour and intellectual labour require different kinds of food. Moreover, many people affect an indifference about food, as though the subject were rather indelicate and beneath consideration, if not absolutely sensual; and the common belief that we should eat to live rather than live to eat, is only a natural prelude to the more singular belief that if we eat life will be sustained. An indifference to the food we consume would be more unjustifiable than an indifference to the way property is invested, or how money is spent; for it is a kind of improvidence which implies a squandering of life's resources, which may be expected to end sooner or later in physical or mental bankruptcy. There are three great ends with which food is taken, all worthy of the highest consideration. They are, first, that we may develop and educate the senses of taste and smell, which are almost as powerful influences in mental development as hearing or sight, though more sensitive and more easily wearied. Secondly, we have to use food so as to secure the full development of body and mind, and maintain both in health. And thirdly, food must be taken with the purpose that the individual and the nation may do productive work. With these conceptions I am disposed to define food as that which ministers to the building of the body, and the healthy performance of all our functions; a definition which will involve elements of nutrition ranging beyond those which are popularly termed food.

If we endeavour to discover the most important kinds of food, it is necessary to know something of the means by which food is made nutritious, and of the processes by which its nutrient material becomes incorporated with the substances of our bodies. And it soon becomes manifest that important as are the solids and fluids which are received by the mouth, the air is a source of food which is more immediately necessary. Good air rapidly restores our powers when exhausted by work, it is taken without intermission; and the quantity taken into the lungs in twenty-four hours is 12,000 to 15,000 litres (a litre being about the capacity of a bottle of wine), equal to 2600 to 3300 gallons. The air which enters the lungs consists roughly of four parts nitrogen and one part oxygen; when it leaves the lungs it has lost one-fifth of its oxygen, which has been absorbed by the body as food. The weight of this measure of 100 to 130 gallons of oxygen, which disappears into a man's blood in a day, is 10,000 to 13,000 grains, and is as much as can be diffused in the blood as it passes through the lung-tissue. But for this air food to carry stimulating energy in its course through the body it must be pure. It becomes contaminated in the lungs by about 4·3 per cent. of carbonic acid gas, which the blood parts with and the lungs expel. And if the air which is breathed contains more than the normal three or four parts in 10,000 of this gas always present in the air, the body is conscious that poison has been substituted for food; and the smooth rosy cheek gives place to a pipe-clay pallor. Yet the difference in percentage composition between the air of a London street and that of a Scotch mountain is almost infinitesimal, amounting to one part of carbonic acid in 10,000 parts of air; but trifling as the quantity is, it becomes in the course of a day an extra litre of impurity breathed, far more than would be tolerated in water or other forms of food. This impure air is one of the conditions of town life, consequent upon the combustion of coal and gas, the effluvia from manufactories, the decay of organic matter, and the respiration of a dense mass of human beings, ever loading the air with this heavy gas. Its carbon blackens our towns. But its worst effects are felt in crowded buildings — churches, schools, law courts, theatres—where, when the oxygen is diminishing in quantity, the attention or interest flags, and the seat grows less comfortable. Those who live much in factories or within the house necessarily suffer more than people whose occupations take them into the open air. But the small rooms, almost unventilated, with perfectly fitting machine-made windows, which modern civilization offers as warm, cosy, and free from draughts, are contrivances for producing what is termed oxygen-starvation, which are only inferior in degree to the historic Black-hole of Calcutta. Among the poor there is a prejudice against fresh air, because it generally means colder air; and with them the warm stupefying atmosphere, laden though it be with poisonous gases and exhalations and disease germs, is balmy and grateful when the day's work is done, compared with the fresh or crisp air outside. Boards of Works and Local Boards apparently have no power to protect such sufferers against their own ignorance; and until an inexpensive instrument is invented for recording the quantity of carbonic acid in the air, they cannot appreciate conditions of a starvation of which they are not conscious. All who can escape, flee from the manufacturing centres to the suburbs, or even to the country, in their search for better air, and thus demonstrate that fresh air is a costly commodity, worth what it costs. He who approaches London by night, and sees, from twenty or thirty miles away, the light, like a dreary dawn, reflected from the hanging dome of carbonized vapour, which flows out far beyond the limit of the greater London of the postal district, realizes best why so many thousands of people travel far that they may breathe during sleep a less contaminated air. While we sleep the muscles, nerves, and other organs which are exhausted with the day's labour are renewed, and we may almost say fed, by the blood. And on the way in which the blood is aerated, the degree of invigoration will depend which we gain from sleep. If curtains are drawn about the bed we shall suffer from carbonic acid poisoning; if the bedroom window is not kept open we experience the effects of oxygen starvation in premature exhaustion of vital energy, of which daily weariness and disinclination to get up in the morning are precursors. If the bedroom window is not kept permanently open, it matters little whether we live in town or country; for the closed window will neutralize at night whatever benefit there may be in the air at other times, and the free circulation of air through a bedroom robs a town life of half its terrors. The majority of bedrooms are too small in construction for the accommodation of more than one person, and children especially, from their rapid respiration, need large rooms and an uninterrupted stream of fresh air.

The effects of fresh air on the body are best seen in a country or sea-side holiday in which the bodily strength gradually reappears, to be followed later by a return of mental vigour. The invigoration may be largely the consequence of the mental influence of change, but there is after all a residue to be set down to purer air. Now, it is this purer air—the purest that is available—that I ask for at night-time, as the condition of a sound mind in a well-nourished body. In the night hours from six p.m. till six a.m. more oxygen appears to be consumed than in the day-time from six a.m. to six p.m.

We get some idea of the function of this oxygen gas within the body when an electric discharge is passed through a muscle of a freshly killed animal. As the muscle contracts it generates carbonic acid and lactic acid. Hence the muscles lose carbon with every muscular contraction. And it is certain that as the blood passes through the minute capillary vessels of the muscle it parts with oxygen gas. By the contractile action of muscular movement, carbonic acid is continually being expelled, while oxygen is as steadily absorbed. Hence the need for an ample supply of oxygen, and our claim to regard oxygen as food. But there is no reason for thinking that the oxygen which disappears in the microscopic vessels of the tissues of the body is given back again as carbonic acid, until it has passed through a series of chemical changes, which are of a different nature during bodily activity from what they are in bodily rest, but which result in some of the old substance of each organ being renewed, like the leaves of an evergreen tree, as the condition of nutrition by food substance. Nature parts with nothing till it has become incapable of useful work; and whether the carbonic acid is passing through the body's tissues in loose combination, or combined organically within its substance, we may hold that just as there is a respiration in the lungs, so there is an antecedent respiration in the muscles, and other tissues, with an interchange of the same gases by the blood.

Besides its direct feeding power, air has a stimulant influence, acting directly upon the nervous system; and few are the persons who are not sensitive to the exhilarating effect of dry air, the soothing influence of moist air, and the varied effects of air in evoking or obliterating the sensations of hunger and thirst.

Next to air, water is the most important food, and the necessity for satisfying thirst is felt more urgently than the demands of hunger in a greater proportion than three to one. In the body of a man weighing eleven stone all the solid substances together only weigh sixty-six pounds, while the water weighs eighty-eight pounds. This water is incessantly being lost and evaporated from the skin, and disappears in perspiration and in other ways. Thus, under ordinary circumstances of rest, the lungs give off about nine ounces of water every day, and the skin of the whole body secretes at least twice as much; while under severe exertion the loss by these means may be enormous. The blood undergoes a further loss of about forty to sixty ounces daily in purification, by passing through the kidneys; so that the fluid waste which has to be replenished daily by food amounts to about sixty-seven to eighty-seven ounces of water. It is preferable that the water we drink should be pure, since many ailments which are not primarily due to bad air may be traced to bad water. Nothing reduces muscular strength and mental vigour in a more marked way than deprivation from water, and nothing restores flagging energy more rapidly. The palate selects waters which are naturally charged with gases, but they are in consequence often charged with mineral impurity, usually carbonate and sulphate of lime. And such waters commonly impair the digestive powers. If present in large quantity the mineral impurity may cause diarrhœa, but a less quantity of dissolved salts will impair the general digestive health. It is well known that hard water roughens the coat of a horse, and thickens the skin, and there is some evidence to show that many minor disorders of the skin in man are to be attributed to a like cause. The only remedy for this in large communities is for the water companies to soften the water as far as possible. But in warm countries, like the West Indies, it is found convenient to drink rain-water as a protection against dysentery as well as fevers; and there is no doubt that the indigestion in our own country, which is due to hard water, disappears when soft water is substituted. The mental irritability which is met with in some parts of the country is often an index of the hardness of the water. And the aggregate loss of productive energy in the nation from this cause, to say nothing of its tendency to diminish happiness, shorten life, and initiate disease, is too serious to be contemplated complacently by any one, because his share in the resulting misery has come by habit to seem small.

Comparatively little of the water needed by the body is taken in the raw condition as it comes to the house. And this leads me to remark upon other fluid forms of food which consist chiefly of water. No doubt they have not all had time to thoroughly naturalize themselves in our country; and the thirsty traveller or citizen who does not find a drinking fountain at hand, experiences some difficulty in satisfying his wants otherwise than at an unreasonable cost. German towns bristle with kiosks in which aerated or mineral waters are sold at a nominal cost. But in London it is only during the night-time that police arrangements permit the sale of tea and coffee in the streets ; and though coffee palaces have established themselves in the West of England, there is still great need for opportunities for consuming drinks other than beer. No tired and hungry workman returning from labour should be induced to take alcoholic stimulants because they are the cheapest or easiest to obtain. I have no prejudice against alcoholic drinks, since processes of chemical change within the body produce the kind of alcohol named cholesterin. And I am not sure that the body does not as a rule produce alcohol enough for its wants. We know that when sugar is dissolved, and comes in contact with a ferment, common alcohol is produced ; and that if the vinous fermentation is unchecked, the alcohol will pass into an acid, as is well known in the domestic manufacture of vinegar. There is more than one occasion in the history of sugar, after it has been consumed as food, in which it comes in contact with a ferment, which makes it possible that some alcohol is produced in the body. But other substances of the alcohol series are certainly produced. Thus cholesterin, the most stable of the alcohols, is always found in the bile, in the blood, and especially in the white matter of the brain, spinal cord, and nerves; and glycerine is an ally of alcohol which is found combined in fats. But besides these alcohols the body yields acetic, formic, and other acids, which may be derived from alcohols, though their antecedent alcoholic condition is too transitory to be recognized. Analogy from the effects of foods would suggest that the high spirits which are chronic in some persons, and occasionally present in others, are consequences of exhilaration engendered by chemical compounds produced by natural processes within the body, in more than ordinary quantity. Nature probably produces the necessary alcohols in the body as fast as is consistent with a healthy performance of ordinary work. If we supplement the natural alcohols with manufactured alcoholic drinks, they should be taken slowly with food. But when it appears that one quarter of the total national expenditure for food is spent upon beer, spirits, and wine, it may be worth asking whether the habitual consumption of such foods has not a tendency to diminish the activity of natural processes of invigoration in the drinker's body; and secondly, whether the effects produced by this food are commensurate with its relative cost? It is a matter of common observation that alcoholic drinks are in most favour between the ages of twenty and forty, which is the time when the natural energy of the body is most exuberant, so that the artificial energy imparted by alcohol is least necessary; but it is also the time when the constitution is capable of enduring the severest strains, so that any injurious effects that alcohol may produce are then least apparent. After forty it is no rare thing for the constitution to cease to tolerate alcoholic drinks, when the drinker makes a virtue of a necessity, and vituperates the kinds of food he may have loved too well. Brewers have not yet directed attention in this country to producing a light, wholesome beverage; but, by using to the uttermost the extractives from the hops, too often produce a great amount of cerebral disorder by means of indigestion, for a small expenditure of money. This condition of sickness, though popularly confused with intoxication, is not usually attributable to the alcohol present, and is a kind of cerebral paralysis which results from what are popularly termed the tonic properties of ale. Although the total expenditure on alcoholic drinks in Britain is £124,000,000, the sum per head spent daily on beer is less than three half-pence; while the daily cost of spirits is three farthings for each individual. These amounts do not suggest anything like excess; and it is only because these payments are made out of a total spent on food of little more than ninepence halfpenny, that we incline to think that the daily cost of drink in a poor man's home is an unreasonably heavy drain upon his means of obtaining nutritious food of a solid kind. Every man must adjust this balance for himself, but to do this we need the diffusion of such physiological knowledge in schools as will demonstrate the relative values of foods, before the habits of life are formed.

The body must be looked upon as a machine which can only do a certain average amount of daily work; and the problem which food presents is, so to take it that we may use up as little of the energy of the machine as possible in the work of assimilation, and produce as much energy as possible, to be available for other labours. Owing to the different properties of foods, under varied conditions of cookery, this is a problem of some difficulty. Food can do but little for us, compared with what we can do for food. We may have the best possible food, well cooked, and yet the body will get but little profit from it unless the food is subjected to the right processes. All food must be masticated, and unless we have teeth fitted for mastication; it will yield us little nourishment. When children are shedding their milk teeth, and cutting the permanent teeth, they are rarely able to learn so well or do such good work as at other times, because they are not so well nourished, owing to imperfect mastication. Perhaps nothing can compensate for the loss of teeth; and the preservation of teeth, which a skilful dentist can often ensure, makes sometimes the difference in life between success and failure. The loss of a single tooth makes a manifest difference in the health, because many kinds of food are useless as nutriment until the ultimate cells of their vegetable substance have been broken between the teeth. And it is the endeavour to compensate for this loss of energy from bad nutrition that commonly leads people to take stimulants as food substitutes. But although this is reasonable until the lost tooth is restored, it is pernicious when made the daily habit of life, because the nerves of taste soon become jaded, and unable to distinguish the natural flavour of the beer, or the other elements of food. Make the experiment of giving the nerves of taste a holiday for a fortnight or a month by abstinence from bitter beer, and not only will every other flavour grow in piquancy, but the beer itself will have a quality hitherto unknown, but which it will not retain above a day or two if the habit of taking it regularly is resumed. This fact, that an interval of several days is necessary before the palate can recover from the narcotizing effects of a glass of beer, is the real explanation of the barbarous cookery which characterizes these islands. You might as well expect a pavior to charm by his elegant movements in a dance, as to find a beer-drinking cook uniform in her work, capable of working on a delicate system of flavours, or able to develop subtle and harmonious gradations of taste in the succession of dishes. And supposing the cook to be able by superior physique and abstinent habits to do the work of her calling in an admirable way, is it not impossible that such pleasures as she may have to impart, should be appreciated so long as those who partake of her work do not discipline their palates to the same high standard? The difference between French and English cookery is based upon the influence on the palate of national drinks; and so long as the Englishman drinks beer habitually, he must be unable to appreciate aromas and flavours which are possible to those whose drink is limited to *eau sucré* or an occasional glass of red wine and water, and he therefore will continue to believe in the superiority of our rough-hewn joints. Skill in cookery is to a large extent thrown away, unless all concerned share in the education which comes from cultivating the senses of taste and smell. The uneducated condition of the British palate is shown quite as remarkably by our consumption of tea and coffee as by anything else. The active principle of coffee which gives it stimulant and sustaining properties, is not the same in quantity in all coffee berries, but in the coffee from Java is greater in amount than in any other kind; and yet no merchant can be induced to import anything better into these islands than Mysore coffee. The mass of the people are not only unable to distinguish between one kind of coffee and another, but usually prefer to have their coffee adulterated with chicory. In preparing the coffee for table, the ground roasted berry is either boiled or infused, with the certainty that half its virtues are lost, as must be, unless part is infused after the boiling is done. As a stimulant, coffee ranks as one of the best. Its invigorating effects are not succeeded by depression, and it has some power in restoring the nervous system to healthy action, when the nerves have experienced partial paralysis from prolonged work or from hunger; and among those engaged in mental occupations, it is often taken with benefit daily into extreme old age. Its action on the body is the reverse of the action of spirits; for while spirits are chiefly useful when taken hot, as a means of procuring sleep at night after a hard day's work, coffee ensures wakefulness. Tea is a stimulant of somewhat similar general properties; and like coffee is also valuable as a vehicle for sugar and milk, and has the advantage of necessitating that the water with which it is made must be boiled. It is probably the most powerful stimulant which enters into the daily diet. It yields, however, a large amount of tannin and extractive matter, which seriously affect the digestion, circulation, and nervous system, when taken to excess. Once a day is as often as tea should be used. But, then, tea is commonly made so strong that no palate can discriminate its delicate aroma. If tea be made in the usual way with boiling water, poured off as soon as made, and then about a table-spoonful of this infusion placed in a teacup, and filled up with water and milk, an elegant and grateful drink is prepared which is sufficiently stimulating, and is harmless. The varieties of tea are as numerous as the classes of wine, and the effects of tea vary with the kind consumed, and with the age of the tea, for when the tea is well manufactured, it improves with age for many years. I have noticed that Assam tea as commonly drunk acts powerfully on the nervous system so as to develop a peculiar, active state of mind, which may be termed irritability, which is often accompanied by a disturbed state of the digestion. Japanese Oolong tea, on the other hand, tends to produce a calm, subdued, contemplative, or even melancholy, way of regarding life. Perhaps the finest tea which can commonly be obtained is pure unmixed Chinese Souchong, which is a powerful invigorator. The process of mixing teas is as unnatural as mixing wines, and, like the glass of Montilla added to an inferior wine to convert it into Amontillado, a little tea rich in aroma or flavour is added to a bulk of inferior leaves, without any advantage to the consumer. Tea is so palatable and excellent a drink, that it deserves much more consideration than it has hitherto received from the consumer. All drinks of this class owe their popularity mainly to their power of arresting waste or nervous exhaustion, and this constitutes their superiority over alcoholic drinks. Neither perhaps is food, in the popular sense of the term. Wine and its allies give a fillip to the nervous system which enables exceptional work to be done, at the price of increased nervous exhaustion—draw a bill on the strength which must be met at a short date; while tea and its allies enable increased work to be done by making the dormant strength available, or discounts on favourable terms the bills on nervous energy which we hold. Both of these processes may be necessary at different times, but the physiological action of tea and coffee is the more desirable, while drinks of this class are less costly than others, the total national expenditure on drink being—

Coffee, etc.	£3,000,000
Water	5,000,000
Tea	15,300,000

or a total of £23,300,000; as against

Wines	£9,000,000
Spirits	40,000,000
Beer	75,000,000

or a total of £124,000,000. So that if tea and coffee were to any large extent to take the place of beer and spirits as national drinks, there would probably result improved health, increased productive work, and a yearly saving in money of from fifty to one hundred millions, which at compound interest might accumulate mainly in the hands of the working classes.

Besides the water which the body loses, there is a daily loss of its solid substance, brought about by the persistent action of the lungs, the skin, and internal organs. This loss is not only a condition of health, but a condition of existence, by which the blood is kept of an approximately uniform composition, notwithstanding variations in nutriment taken; and by it the products of wear and tear of the several organs which make up the machine of the body are eliminated, after the blood has removed the waste substances from the tissues. In the adult man the loss of solids amounts to something more than two pounds daily, so that if we add to this quantity the fluid loss, the total weight which the blood loses daily is about seven pounds, out of a total of twelve or thirteen pounds of blood which the body contains. Nothing brings into more striking evidence the necessity for food being taken at short intervals, to restore this unceasing drain upon the vital fluid. But although the daily loss is equal in weight to more than half the weight of blood in the body, the loss itself does not correspond with blood in chemical composition; so that we have not to make seven pounds of new blood a day, but in the case of the adult to add seven pounds of new material, with which the blood-making organs will repair or restore the exhausted fluid, and of this material more than two pounds must be solids. The percentage composition of the solids of the blood is—

Carbon	51·96
Nitrogen	15·07
Hydrogen	7·25
Oxygen	21·30
Ash	4·42

The composition of the solids lost by the body daily is—

	Grains.
Carbon	4000
Nitrogen	300

	Grains.
Hydrogen Oxygen	9800
Ash	400

So that there is a relatively small loss of nitrogen and a moderate loss of carbon; and it is this loss which we employ all the resources of nature in food production, and of art in food preparation, to make good. Limiting ourselves to the idea of sustaining the body, our first object is to take no more food than is necessary to restore the wasted tissues; because all food taken in excess of this quantity exhausts, instead of invigorating, and simply inconveniences all the organs with which it comes in contact. While in selecting our food we have not only to avoid strain of laborious mastication, and guard against the slow solution of food-substances by the juices of the body, but to see that the solids taken are such as will make good losses which the human organization ensures, with the least possible expenditure of energy. And although this problem looks simple enough from a chemical point of view, in the practical physiology of life, it is highly complicated, owing to the ways in which existence is inseparable from its successive phases and from life's work, both of which imply other condition for nutrition than mere repairs to the human machine.

Thus in childhood and youth all those processes go on which result in loss to the body of the adult, but they are all far more active, so that the waste of the body is relatively greater in the earlier years of life than at any other time. But in addition to this the body is building; and therefore not only must the food make provision for daily increase of the tissues, but the food necessary to construct the body and blood requires a different and much better diet than will suffice to keep the organism in sound working order when its full development has been attained. The frequent recurrence of hunger in children, and their marvellous appetites, make manifest the necessity for abundant food, but if the parental watchfulness is to do all that the necessities of the children require, the food must more nearly correspond to the composition of the blood—be richer in nitrogen and carbon—than that which is provided for adults. These requirements are abundantly met by the use of such foods as milk, butter, cheese, eggs, and jam, which are always welcome elements in juvenile diet. The old teaching, milk for babes, has a significance beyond what might be obvious at first sight. Infants thrive on it, but it is better suited in its uncooked state to the infantile period than to any other epoch of life. Its immediate effect is to produce a state of exhaustion under which the child goes to sleep; for when the milk comes in contact with the gastric juice, which its presence in the stomach causes to be secreted, it is coagulated, and undergoes exactly the same change as is produced artificially when milk is converted into curds and whey by the addition of gastric juice from the stomach of the calf. This solid mass of curds is difficult to assimilate, and has to be slowly dissolved after it has been formed. The process exhausts the nerves named vagus nerves, which come from the base of the brain, and are distributed over both sides of the stomach, so that the nerve-centres of the brain and vital organs share in the nervous exhaustion, and sleep comes on while digestion is in progress. Clearly it would be inconvenient if sleep followed the consumption of food with older people; but since the youth would swallow milk in larger quantities than the infant, it would, if taken raw, solidify in larger masses of curd, with a resulting heaviness or drowsiness, if not sleep, if milk were his habitual food. Hence so soon as the teeth are available for mastication, milk is solidified by cookery in all kinds of vegetable puddings, such as rice, sago, tapioca, and custard, so that it may be thoroughly broken up by the teeth and fitted for the digestive process. No small part of the purpose of the simpler forms of cookery is so to alter food that nervous exhaustion cannot be a consequence from digestion, and to ensure immediate invigoration from absorption of the food-substance.

The chief kinds of food which make up the daily nutriment of most people include milk, eggs, cheese, bread, fruit, fish and meat, butter, potatoes and other vegetables, and sugar. From their chemical composition foods are often grouped into four classes. First, there is food which contains nitrogen in addition to carbon, hydrogen, and oxygen. This is termed nitrogenous or proteid food, because these four elements when combined chemically form the substance "protein," which is necessary for the formation of nerve and muscle. The fats are formed of carbon, hydrogen, and oxygen, but with more hydrogen than could combine with the oxygen to form water. They may accumulate in the body a reserve store, which will supply carbon for work in time of need.

The amyloid foods also consist of carbon, hydrogen, and oxygen, but with only so much hydrogen as would combine with oxygen to form water. The types of these foods are starch and sugar. They need efficient mastication, and are the chief carbon supply for daily work. And there are small quantities of mineral food, such as salt. This chemical classification teaches us how to combine foods so that the digestive organs may have no more work to do in sustaining the body than is inevitable. For man cannot live by bread alone, or by any other single food-stuff, without a degree of wear and tear which reduces the strength, and so tends to originate disease and shorten life. If, for example, a man takes as much food as he can eat, but food that contains less nitrogen than his body loses daily, he must suffer from nitrogen starvation. And since the nitrogen is necessary to build up and to replenish muscle and nerve, it follows that any under-feeding in the matter of nitrogenous food must bring about fitful nervous excitability in place of the calm strength necessary for a life of sustained effort, and at the same time diminishes the power of the muscles to do the work of life. And if, on the other hand, the food is too rich in nitrogenous elements, an immense quantity of it must be taken to obtain the carbon which the lungs and other organs separate in carbonic acid. And this implies unproductive and harmful work for all the organs concerned, so that the strength which should have gone to make the enjoyment of the day's labour is used in securing nutrition, with the result that life is robbed of the sense of happiness, even if a sense of misery does not come instead.

This aspect of the physiological economy of food is not merely a question which concerns us as individuals, but has an important bearing on the prosperity of great national industries, and is not without interest for the politician. It is quite possible that we are all spending far too much money on food, through disregard of its chemical nature. We know that in India the average earnings of the people are about two shillings and threepence a week, and although it is not to be expected that a British family could ever live and labour upon such a sum, the fact that the inhabitants of other European countries live at less cost than our own people is the main reason why they are content with lower wages, and able to undersell this country with their manufactures, and come into competition with us. A Parliamentary commission might be engaged on many a less profitable investigation than a study of the foods and relative costs of national foods in countries with which these islands trade. We must never forget that inherited habit is more powerful in regulating the foods in immediate demand than even the supply in the markets; but we have learned that education is capable of varying habits in no long period of time. In a former age, when the population of these islands was only a fraction of its present amount, and the home-grown food supply was ample for our wants, it was natural that the foods in demand should be those which the land supplied; but with the change of industries consequent upon the applications of the sciences and arts, which have drawn so large a part of the people into the sedentary occupations of town life, it is no longer reasonable to preserve the habits which ancestors developed in agricultural pursuits, any more than it is wise to imitate the food consumption of the more wealthy. Just as the manufacturer endeavours to make his goods at the least cost, and avails himself of every discovery by which material, labour, fuel, may be saved or utilized, and production increased, so it befits the intelligence of the British people that they should apply the same principles to their own sustenance by food.

Almost every nation follows distinctive principles in its food. And even in these islands there is hardly a district or county which has not local habits, or at least preparations of food held in especial honour. In some cases these are of more than local importance.

Thus, in Scotland, we find porridge holding a place in the daily food that is unknown in the South of England; while in Ireland the potato has an importance which is otherwise unknown, it being stated that an Irishman will sometimes consume ten and a half pounds of potatoes a day. Here we have the Irish people making a food which is essentially amylaceous the basis of its diet. The potato contains 75 per cent. of water, about 23 per cent. of starch, with a little sugar, and less than 1½ per cent. of nitrogen. The potato is by no means a bad form of food, though it contains but little nitrogen. Moreover, potatoes are difficult of digestion when they are not floury, and are of little value unless thoroughly masticated. If the starch-cells are well broken up and mixed with saliva, then the starch is speedily converted into sugar, which is easily absorbed and assimilated; but, unless a large quantity of potatoes is taken, there is danger of a deficient supply of nitrogen. There is reason to think the excitability and political unrest of the Irish people is very much a question of diet, since it disappears under the different food conditions of army life. And when we contrast Scotch enterprise with the less marked development of this quality in Ireland, we may study the influence of a diet better calculated to invigorate the nervous system. Here, then, we see that the body needs, from a chemical point of view, some protein compound or nitrogenous food, and among such we have the choice between the gluten of flour, the caseine of cheese, albumen of eggs, syntonin of flesh, and fibrin of blood, not to mention gelatine, which is obtained from the connective tissue or skin. And we also need a quantity of amyloid or fat food. Now, if we ask, What foods shall we select? science would say, Having found such as are chemically suitable, prefer the foods which are most easily taken up into the substance of the body, which occupy the smallest bulk, and which can be obtained at the smallest price. And it would especially urge us not to be guided by one food being in its natural state more acceptable to the palate than another, because a slight knowledge of cookery is sufficient to change the balance of attraction in any way we may desire; but if a food is desirable from its chemical composition, and cookery is available to make it appetizing, then we should be guided in our selection chiefly by its relative cost. If as good or nearly as good a food can be purchased for a penny as for sixpence or a shilling, then we have made a step in more problems than one, and, by economy in expenditure on food, have settled many a difficulty concerning matters of wages, and the profitable pursuit by manufacturers of industries which wages govern. The commercial prosperity of the country is in the hands of the industrial classes, and can only be developed by habits of thrift causing them to seek more nutritious foods, which cost less money than those at present consumed; for if the food of a family costs four shillings a week less, the artisan would be better off with two shillings a week less wages than now.

Among millions of the people the expenditure on food is not a large daily amount. Professor Leone Levi has calculated that if the entire earnings of the British people were equally divided, they would only yield about one shilling and fourpence halfpenny a day for each individual man, woman, and child, and of this sum about sixpence halfpenny a day is spent on forms of solid food. In proportion to the smallness of the sum available is the urgency that the best nutriment available for the money should be obtained; but, except in a few items, I do not find any material difference in the relative sums spent upon articles of diet in the average income of twenty-eight pounds a year, and the professional incomes of five hundred to eight hundred pounds a year. The smaller the income the larger relatively are the sums spent upon bread and milk, but the differences in vegetables and meat, though perceptible, are not so striking. This may be seen from the following table, in which the average daily expenditure of a household is stated in pence and fractions of a penny on one side, and is multiplied in the right-hand column so as to increase the sum spent on these items yearly to two hundred and eighty-nine pounds, which is about the proportion in an income of eight hundred pounds a year:—

EXPENDITURE ON FOOD.

	At 9·6*d*. a day, or £28 3*s*. a year.	At £289 a year.
Meat and fish	2·13	£63 18
Milk and eggs	·78	23 8
Bread	1·41	42 6
Potatoes and vegetables	1·00	30 0
Butter and cheese	·67	20 2
Fruit	·19	5 14
Sugar	·50	15 0
Tea	·60	18 0
Coffee, etc.	·05	1 10
Wine	·16	4 16
Spirits	·75	22 10
Beer	1·40	42 0

Hence it is manifest that the chief elements in the solid food-stuffs which distinguish the diet of the working class from that of the middle class are on the whole satisfactory, but the larger proportionate consumption of bread makes it probable that the details of the diet are less satisfactory, and that there is less preparation of food by cookery.

It is eminently desirable that a professorship of food and cookery should be endowed in every great industrial centre, mainly with a view to the best scientific regulation of dietary and cookery in relation to the daily labours of the people. At present there is some amount of waste in all cookery, just as there is waste in the injudicious combination of foods; and this waste represents many thousand times the cost of the best professional teaching, by means of which it could be saved. It is not enough to have teaching. What is needed is experimental research, based upon the local facts, habits, and circumstances, which shall demonstrate to us how to eat and drink wisely.

After cookery has made the food acceptable to the senses of taste and smell, its first business is to facilitate the digestive process by diminishing the mechanical labour which the teeth perform, and assist in the solution or alteration of the food by the juices of the digestive organs. Thus all nitrogenous food undergoes the changes which convert it into nutriment in the stomach, and there is no advantage in masticating it, except in so far as mastication ensures division of the cells and fibres. If the pestle and mortar, chopping-board, or sausage-machine can do the bulk of the work as well as the teeth, it is waste of strength to disregard such help. But while it is unnecessary that protein substances of meat should be mixed with the saliva, it is indispensable to thoroughly masticate the nitrogenous forms of vegetable food, because they all contain a large percentage of starch, which replaces the fats of animal food. When these nitrogenous foods have been swallowed, they are dissolved by the gastric juice in the stomach, and by the pancreatic juice in the small intestine, forming peptones, and thus become diffusible into the vessels named lacteals, which line the small intestine. But all forms of nitrogenous food are not digested with equal rapidity. Only one hour is required for the conversion of tripe and rice into peptones, so that those substances are adapted to be eaten together. Salmon, eggs, and venison are digested in an hour and a half, and their easy digestibility is due apparently to the ease with which the connective tissue of venison and fish are dissolved. Milk and fish generally, require two hours; beef, mutton, and fowls need three hours to three hours and a half; while veal is less easily digested. After digestion is complete some short interval should follow for assimilation before food is taken again. So far as regards nutrition, there is not much reason for preferring one form of flesh food to another; the preference must be gathered by the rapidity with which it invigorates the strength, and the ease with which it can be obtained. Thus, there can be no comparison between the superior effects of a meal of tripe and rice as a rapid invigorator, when compared with fish, beef, or mutton; and it is manifested in a clear brain and a degree of nervous energy which could not otherwise have been secured in the time.

No small part of life is practically unproductive, in consequence of the long intervals which the foods commonly taken require for digestion. I am hence led to recommend foods which contain the proteid legumine, as capable of furnishing an easily digested nitrogenous substance at a moderate cost, and believe that the more general use of beans, peas, and lentils as food would be desirable in the interest of productive work. The great objection to all the nitrogenous forms of vegetable food is their freedom from fat, though this can be added in cookery. The problem comes to be one of cost; fish, flesh, and fowl varies from, say, sixpence to two shillings a pound, and, unless cooked by stewing, loses so much in the process that its cost becomes enhanced one-fourth, and when to this is added the waste from the presence of bones, the cost of even the cheapest meat must often be about tenpence a pound. When this price is compared with the cost of any of the nitrogenous vegetable foods, it ranges from five to ten times their price. The vegetable foods are just as rich in nerve and muscle forming substance, and with the addition of a little art in cooking are not inferior foods. If the same amount of nutriment can be obtained from vegetable food, digested in less time, and purchased at far less cost, the balance seems to incline in its favour. The difficulty which such foods have in getting their merits recognized is dependent chiefly upon their inferiority to animal foods in fulness of flavour, unless skilfully cooked; and as I do not anticipate that this difficulty can be got over for some generations, I would suggest that the right use of animal food should be as a flavouring to vegetable food, in stews, soups, rissoles, and the many types of cookery in which the accustomed flavour is grateful. Another defect is the absence of fat in these vegetable foods; but though fat is pleasant to the adult, it is intolerable to the young. I have no doubt the variety and delicacy of the vegetable flavours would soon educate the palate to a preference for them, if the experiment were made of introducing such dishes gradually—say, once or twice a week. In many continental countries the vegetable foods are eaten as separate courses. I need not speak of the important place which the whole class of maccaroni preparations holds in the daily diet of the Italian, or of the class of hot salads of the South of Europe, in which the cauliflower and many other vegetables are made delicious with a little oil and less vinegar, or with cheese. But if we once start on the path of economy in food, the resources available will be found almost inexhaustible. If we are indifferent to the urgency of providing cheaper food for our support as a nation, we are only playing into the hands of our competitors in the industrial markets of the world. The sum annually spent in this country on meat is more than £114,000,000, or upwards of a ninth of the national income; while the sum spent on bread, potatoes, and vegetables combined is £127,000,000. By a reformed diet it is probable that a substantial saving of about £30,000,000 a year might be made, in the cost of nitrogenous food alone, without any serious change in national habits, and with advantage every way.

The difficulty in making the change is essentially governed by our prevailing ignorance of cookery, for the ease with which meat can be baked or boiled interposes a powerful practical advantage in favour of the food which gives least trouble. But even if the diffusion of this knowledge cost the nation half a million of money a year, it would be wise economy to take such steps as would enable our countrymen to adopt the cheaper forms of food, which continental experience and scientific research have proved to be valuable. I cannot help recalling the waste of fuel and material, to say nothing of time, which always takes place when the cookery is performed, as now, in each dwelling, over so many separate fires. Any one who can recall the conditions of college life in the old universities, in which an efficient cook does the work for all residents in a college, will probably regret that so little of the same principle is to be found in the philanthropic and commercial efforts of our own time for the better housing of the working classes. Yet the saving which would result from having a common kitchen and common hall for food in every composite dwelling, would free a woman's life from half the cares of the house, would ensure the man's food being always ready, and would make the introduction of cheaper forms of food easy for a not inconsiderable section of the people. It would, moreover, secure the best food obtainable, at the lowest wholesale price, delivered at the dwelling, without thought or effort on the part of the consumer, and ensure it being cooked and served with appliances which only much larger incomes can at present command. Just as factories have been erected that industries may be carried on with economy, so it has become urgent, in order that those industries may exist, that the working man should also share in the advantages of co-operation, by having his own store for supplying the necessaries of life, his own cook and kitchen for the common benefit of those dwelling together, and his own dining-hall where fellow-workers may meet. What has been accomplished by wise management in some of the great public schools, shows that the co-operative principle may be extended with infinite advantage in the matter of cookery.

Very little is known accurately as to what happens to the constituents of food between their passing into the body and being converted into blood. It is certain that some peptone is absorbed by the stomach itself; it is probable that some sugar and, perhaps, a little fat are taken up in the same way; but whether the fat is in a simply emulsified form or converted into a soap is not clear. But beyond all doubt much of the food is absorbed directly into the blood, and passes from the stomach through the liver, where it undergoes changes which lead to the formation of sugar and some blood-corpuscles; but after the chyme has left the stomach, the juice from the pancreas, and bile complete the digestive process in the intestine, forming grape sugar out of starch, emulsifying fats, and perhaps forming some soaps, after it has divided the fats into fatty acids and glycerine. It also dissolves proteids, forming peptones. Now, all these substances formed in the intestine itself are necessarily absorbed in the intestine. They are taken up by organs termed lacteals, one of which is contained in each of the delicate organs named villi, which line the small intestine. But how the absorption takes place is not clearly understood; whether the villi, by muscular contraction, have the action of innumerable suction-pumps, or whether the chyle gets into the villi by some other means, is uncertain, and all we know is that the chyle contains about nine per cent. of solids of which four to five per cent. are proteid matter, and three to four per cent. are fat, while the remainder consist of salts. Now, this chyle passes through a succession of glands named lymphatic glands, before it reaches the duct named the thoracic duct, which conveys the fluid, after it has been altered by these glands, into the blood. The fluid, after being altered by the glands, is termed lymph, and has acquired the power of coagulating; and after standing at rest develops a pink film on the surface, which is attributed to the formation of immature red corpuscules. But what becomes of the fat in the lymph after it reaches the blood, no one knows; and all that can be said about it with certainty is, that it is turned to excellent account in supporting the body. A fatty food may lead to the accumulation of fat, and yet the fat stored in the body is not the same as that which is eaten; for not only are the fats of venison, mutton, beef different from each other, but the fat in man is distinct from all, though the difference is chiefly in the proportions in which the fatty substances, like stearin and olein, are combined together. There is good experimental evidence for believing that fat may be formed out of proteid substance, in which case it always results from a breaking-up of the protoplasm into fat and some nitrogenous substance. For it has been shown that the butter in cow's milk occurs in much greater quantity than the fat present in the food the cow consumes. Sugar and starch in food both tend in some unknown way to facilitate the storing of fat in the body. The fat itself is assimilated in a very finely divided condition, and the action of common salt upon fatty substances facilitates their conversion into this state, which is termed an emulsion, so that they can pass into the body. There is less difficulty in obtaining foods which furnish abundance of starch and fat, than in obtaining nitrogenous food, for they are more abundant in nature and command a lower price.

Chemical changes and muscular movements are always going on within the body, even when it seems most perfectly at rest; and from the time that food is taken, till it leaves the body in the condition of carbonic acid, water, and nitrogenous compounds, it is ever undergoing chemical change, by combining chiefly with oxygen gas. It thus gives rise to the formation of a multitude of substances in succession, which are eventually simplified into water, carbonic acid, and urea. Every one of these changes gives rise to the liberation of heat, so that the temperature of the body is maintained by chemical changes, ever going on within it. It is estimated that four-fifths of the energy which food imparts to the body is converted into heat. The heat produced by the oxidation of a pound of fat is the same, whether the fat is consumed slowly in the body, or burned rapidly in the air; and in both cases the ultimate products of the combustion are carbonic acid and water. Fat, therefore, no matter how it may originate, becomes a source of energy. I have little doubt that it is chiefly formed out of the proteid substance of the blood, because it is found in largest quantities in positions and under circumstances in which the blood would form it. Thus the influence of cold, by closing the pores of the skin, diminishes the perspiration, and the constituents of the blood which previously disappeared through the skin as carbonic acid and water accumulate beneath the skin, forming fat—a condition which is exceptionally developed in the blubber of whales and other marine mammalia which frequent cold seas. Fat is also commonly developed about the kidneys; and here it would seem that when the diet is ample and favourable, the constituents of fat transude through the external surface of the kidneys into the surrounding tissue, while those organs separate the waste nitrogenous substances from the blood in a way that is suggested by the secretion of fat in milk, produced by the action of the mammary gland in separating from the blood the nitrogenous substance caseine. So long as fat does not take the place of protoplasm, or partly replace the nitrogenous substances of the body, it always serves the same purpose as the fat of a hibernating animal, forming a reserve store that is drawn upon in times of sickness or scarcity, to supply the carbonic acid and water needed to sustain respiration, without attacking the nitrogenous tissues of the body.

The final purpose which food serves, after it has restored the waste consequent upon the internal work which is ever going on in the tissues, is the production of heat, nervous energy, and muscular energy; or, in other words, the liberation of energy, by which external work is done and life is made productive.

If it were asked where the heat is produced, the reply is, in all places where chemical change is in progress; but no small part of the heat of the body under ordinary conditions of rest is produced in the liver, where the blood may be several degrees warmer than that in the right side of the heart. The brain, too, is hotter than the blood which supplies it, and therefore it also must warm the blood, though in a less degree. But the muscles are capable of generating by their contraction an enormous amount of heat. We are conscious of this heat during all kinds of active exercise and severe bodily labour; and it is accompanied by a large evaporation of water from the skin, which helps to keep the skin cool, and by a greatly increased liberation of carbonic acid in the lungs, but not by any material increase in the amount of nitrogenous waste. Hence, if we separate in imagination the idea of a subsistence diet, which would preserve the body in health while it remained inactive, from the idea of the additional diet, which would enable it to perform hard work, and which may, therefore, be termed a hard-working diet, the loss which the body experiences in work, involving only the oxidized constituents of fat, shows that we may replace the loss of heat, water, and carbonic acid with fatty foods or starchy foods, which the body is able to convert into these products.

We may diminish the necessity for heat-producing foods by controlling the loss of heat. For, since the larger part of the heat of the body is radiated and lost by the skin and lungs, it is possible, by the use of woollen and other clothing, to lessen the escape of heat; and so, keeping the body warm by means of its own heat, we need less heat-producing food. If the warm clothing is not used, Nature will probably make it for herself, by putting on a layer of fat beneath the skin, which serves as a great-coat; but even this is kept in better condition with warm clothing than without it.

Thus, since muscular labour and brain work are both dependent upon foods which keep up the temperature, we arrive at the conclusion that the productive work of life is done best by taking, in addition to a subsistence diet of nitrogenous substance and starch or fat, an extra quantity of starchy or fatty food. It is certainly a mistake to attempt to take an extra quantity of meat, because little more than half as much work can be got out of beef flesh as out of beef fat; and I have no doubt that rice with milk, butter, or jam, any kind of salt fat, or potatoes with salt and butter, would be preferable to meat. It is not, then, hard work which requires costly food; and one may say the expenditure on the human machine is much heavier for daily repairs on account of the work which it does in keeping us in health, than for the fuel which enables it to perform such work as the world offers.

Since energy is liberated in the nitrogenous tissues, muscles, brain, glands, etc., it was natural that Liebig and those who first studied the relation of food to work should have supposed that those tissues were consumed in the work performed. But investigations since made have shown that though the muscle, for instance, by contraction loses carbonic acid and forms lactic acid, yet its nitrogenous substance is not broken up by work; but, on the contrary, it is stimulated to increased assimilative power, so that when the work is severe it not only repairs the waste from the blood, but forms new muscular substance in consequence of the work performed. This shows that the loss experienced in hard labour renders an organ capable of better nutrition than is possible with moderate labour, and hence the wisdom of not limiting the nitrogenous elements of food to the exact quantity needed to sustain life, although the greater part of muscular waste is renewed from the non-nitrogenous elements of the blood. The scientific reason for this is that certain living membranes only allow some definite chemical substances to pass through them. This process I termed organic dialysis. Its action is such that envelopes which contain the substance of muscle fibres or nerve-cells only absorb the constituents of those fibres or cells from the blood, or only absorb from the blood such constituents as may be lost by the cell or fibre in consequence of work performed. It is inconceivable that any tissue should be destroyed by the work it performs, unless its activity is such as to preclude the possibility of its nutrition by the blood during periods of rest. Therefore, after the nitrogenous tissues of the body have grown to their adult dimensions, the effect of exercise, which forces blood through them, is to renew certain non-nitrogenous constituents in a form which will again enable the organ to liberate heat during its functional activity, or do the amount of mechanical work to which the heat is equivalent. It is probable that in this process some waste nitrogenous matter is set free, as we know to be the case with the ordinary nutrition of these organs when doing the internal work while the body is in a state of rest, which accounts for the bulk of the nitrogenous waste, for this is only slightly augmented with exercise.

The mechanical force which is to be obtained from food has been carefully determined by Dr. Frankland, with the result that one gramme, which is equal to 15·432 grains, when oxidized, will furnish the power necessary to lift a number of pounds' weight, which varies for each food, to the height of one foot, and this expression is termed work in foot-pounds.

Thus, a gramme of beef fat will lift 27,778 foot-pounds; the same quantity of lean beef is equal to 14,803 foot-pounds of work. Starch is equal to 11,283 foot-pounds. So that the work obtained from the fat element in diet is nearly twice the energy produced by lean food, and is nearly three times as much as can be got out of sugar. We shall get the best idea of the value of foods by first considering the physical work which a man commonly performs. Thus, assuming that the work of walking on a level surface is equal to raising one-twentieth of the weight of the body through the distance travelled, it follows that a walk of one mile by a man weighing one hundred and fifty pounds is equal to 17·67 tons lifted one foot; twenty miles walked equals 353·4 tons lifted one foot, while if the man at the same time carries a load of sixty pounds, his work is increased to 495 foot-tons. The same amount of work may be done by lifting weights, turning a winch, striking with a hammer, etc. It appears that the ordinary labour of a working man varies on an average from 300 foot-tons to 500 foot-tons; and the internal work of the body is estimated at a similar amount. The external energy is estimated at less than one-tenth of the energy due to the oxidation of food—four-fifths goes to produce heat; but I incline to think the internal work is more than one-tenth. In any case, the diet should be arranged so that the energy obtainable for the sustenance of the body should be estimated separately from the energy necessary for daily labour. Taken as extra food, the combustion of—

1 oz. of	butter	furnishes force	equal to lifting	281·0	tons.
,,	Cheshire cheese	,,	,,	168·5	,,
,,	oatmeal	,,	,,	152·0	,,
,,	flour	,,	,,	148·5	,,
,,	rice	,,	,,	145·3	,,
,,	sugar	,,	,,	129·5	,,
,,	bread	,,	,,	83·0	,,
,,	lean beef	,,	,,	55·0	,,
,,	potatoes	,,	,,	38·5	,,
,,	milk	,,	,,	24·3	,,

So that an *extra* ounce and a half of butter, or five ounces of bread, or eight ounces of lean meat, would, when oxidized, liberate the energy necessary to do a good day's work. Our choice of labour diet, as distinct from subsistence diet, must depend upon the nature of our labour. In the matter of cheapness, in cases in which hard work is involved, the largest amount of work may be done for least money on oatmeal; bread is rather more costly, and beef fat dearer still; but the equivalent of half a pound of beef fat is two and a third pounds of bread. But though five pounds of potatoes may enable us to do the same work as half a pound of fat, and cost as much, the bulk makes them less desirable, and they are a dearer food on account of the greater physical effort in converting them into work. But some regard should be had for the seasons, during which the customs of peoples living under different climatic conditions to our own may be observed. Thus, in the Arctic regions the only non-nitrogenous food is fat, and in the tropics fats are largely replaced by starches and sugar. Hence fat may be more desirable in winter, while starchy food may serve as well in the hot season. And the change of temperature with day and night is probably the reason why both fat and starch have been found desirable elements in the labour diet of nearly all peoples.

The standard diet for a working man is estimated as being twenty-three ounces of dry solid food, equal to about forty-six ounces of food in the form in which it is consumed. This consists of—

	Ounces.		Foot-tons.
Nitrogenous matter	4·587,	producing force equal to	744
Fatty matter ...	2·964,	„ „	1055
Starches	14·250,	, „	2161
Salts	1·058		

This is not found to be sufficient for hard labour. In the Royal Engineers the nitrogenous food is half an ounce more, with eight ounces more starches, making up the force value of the food to 5232 foot-tons, or ten times the external work.

If more food is taken than can be utilized in work, the health suffers as much as though the foods were taken in incompatible proportions; while a diet which is insufficient in any respect must result in mental or physical feebleness. And nothing but experience can determine for any individual what quantity of food should be taken; for, like the kind of food, it must vary with habits and pursuits. There is much evidence to show, however, that under-nutrition is the cause of a good deal of bad work and moral depression, and probably of crime itself. The converse of this is also true, for the exuberant liberation of energy which follows on full nutrition leads to a prodigality and thoroughness of labour, as the condition of existence; so that the moral qualities of courage and honesty of effort express themselves spontaneously. And the mental condition reacts on the body so as to govern nutrition. For if the nervous system be so ill nourished as to be capable of manifesting passionate excitement, or incapable of relaxing nervous concentration on a pursuit or an idea, then the bodily energy is drawn off to the brain, and not available for the work of digestion; so that, although suitable food be taken, the body is ill nourished. Hence the advantage of the social habit of taking our daily meals; for nothing fits the nervous system for the work of digestion so well as the relaxation of laughter, which is rarely wanting where youth is able to impart its wisdom to those who seem old enough to have lost whatever wisdom they started with.

If, then, we build up our bodies by eating wisely and not too well, avoiding alike exhaustion from too little and too much, we may hope to take our part in doing works which will live after us, imparting while they endure some of the pleasure and delight which we feel in our labour.

If I add a word more, it is because there is an ever-extending habit in so many nations of introducing tobacco at the close of the day, if not after every meal; so that it has come to be a concomitant of food, even when it does not act as a substitute. The nervous system is influenced by tobacco more potently, perhaps, than by any other external influence; and, when taken at an early age, there is, probably, no influence more unfortunate in its effects, for it antagonizes the energetic action which food stimulates. It produces the calm of age, before the fire of youth is fairly kindled; and moderates the hopes and fears of life, so that the habitual smoker rarely seeks its prizes. The smoker is often content with believing he can do work, because he has tamed the impulse which would have compelled him to work. The smoke becomes a cloud, which too often comes between a man and his duties; and the stimulus of an ordinary diet disappears before the philosophy which it calls into existence. When taken later in life, it may regulate digestion by the forgetfulness of the world which it is apt to encourage. But its chief effects are felt best when taken after severe mental labour, for it restores the tired nerve-cells to a state of healthy action and obliterates fatigue. In a few minutes effects are experienced which only hours of rest could have otherwise produced. And this is, therefore, the secret of the favour in which tobacco is held by men of nervous temperament. Its advantage over all stimulants as a restorative is manifest in producing no after effects, but it is to be taken only when urgently required for its virtue to be kept unimpaired. But when we contemplate how freely tobacco is consumed, growing into a habit which rules the smoker like drunkenness or gluttony, we cannot but dread the consequences in dissipating national energy, and fear that any effort to improve the food of the people and make men more energetic will fail, if it has to contend with the relaxing influence of tobacco. The peace which tobacco brings to the young man is bought at the price of keen joys of brain and sense, and is taken in exchange for the sensitive palate which simple food-flavours keeps fresh, and power of smell which makes us garnish the house with flowers; and it is, moreover, an inglorious peace snatched while the battle of life has yet to be fought, and in disregard of the achievements and happiness with which food, chosen well, may enable us to enrich existence.

EDUCATION.

NEITHER the nature of education nor its effects are quite self-evident. Both enlist the sympathies of parents, teachers, and pupils, who believe that education guides experience like a mariner's compass, and who know that the effects of education influence us like sunshine. Education is the lamp of life; but it does not follow that there can be no light because the lamp is not of the common pattern: there is a genius of the lamp. Just as we rejoice in the warmth, light, clouds, colours, blossoms, foliage, with which sunshine enriches earth and heaven, without often knowing how the sun imparts such gifts to man; so we feel the human warmth and brightness which bathe existence, streaming upon us from human experience in past ages, from other peoples, from our own pursuits, but are often too busy, gathering flowers of happiness from the passing currents of life, to reflect how we are moulded by these surroundings, or gain from them power of interpreting the mystery of existence, and of finding our way happily through the years. This method in life is our education, and the fruits of lives vary as the methods differ in which we are educated. If the method of life is clearly understood, the plan of a man's whole existence only differs from the details of a passing day as the government of a family differs from the conduct of an individual, and as the administration of a nation differs from its unit, the family. Here it is that our days are bound each to each by filial piety.

In education, as in other matters, the means available determine the end to be reached; though we know that in exceptional cases the end creates or discovers the means for its attainment. If we have to make a cart-wheel or chair, we first estimate the uses to which the result of our labour will be put, and, secondly, the materials out of which the fabrication must be constructed. When life is looked at as a whole in this way, the conception of education grows clear.

What is it we would do with the energy and aspirations within us? And how far do we propose to attain these ends by self-denial in adapting ourselves to varying circumstances; or do we contemplate that severer self-denial and renunciation which compels circumstances of life to adapt themselves to us? We may not consciously acknowledge these problems, yet to enter on life without considering them is like starting on travel without map or compass. Travel may yield pleasure enough without such guides, and the roads are sure to lead to haunts of men; but even when the traveller is of such stuff as explorers are made, he must miss many a thing in an unknown land, and waste time by neglecting human experience. But when we begin to learn what we desire life to become, you find that, though the limits of choice are wide, men, as a rule, only mould their own lives as gardeners vary the lives of plants. The gardener may trench the ground, or choose, or suitably manure it, clear it of enemies, or restrict the blossoming; but the bulb or seed will unfold itself according to its inherited nature, which may vary a little spontaneously. Hence there is an inheritance in each of us which is an epitome of ancestral energy, acting in bodily structures which in like manner have been handed on. We cannot vary the amount of this vital inheritance, though we determine the rate at which it is expended or augmented by education.

The unfolding of our mental characteristics with successive decades of life is popularly stated, and no doubt on careful induction, in the rhyme—

"At ten a child, at twenty wild,
At thirty tame, if ever;
At forty wise, at fifty rich,
At sixty good, or never."

This common view of life puts before us not only the fact that man, like a plant, has his periods of exuberant energy and of fruition, but also the cardinal fact that he has but a definite number of years of activity. The average duration of life in the labouring class is, I believe, about twenty-seven years, and in the professional class about forty-seven years; though it may be enough for each of us to take the estimated duration of life, calculated by insurance offices, as setting before each individual the time available for acquisition of knowledge, for education, and the achievement of life's endeavours. Yet even this lifetime appears at first sight longer than it really is; and the longest lived and most laborious intellectual labourers have, when their working hours are all added up, only about eleven or eleven and a half years of intellectual work. For most of us the time available for life's labours is far shorter; and therefore I put the question, What education is there worth having, and capable of being attained, that will make the results of life which will endure of most value to ourselves, to those among whom we live, and to those who succeed to the small inheritance of each man's toil? And, to answer this question, we must be careful not to confound means of obtaining education with education itself. Reading, writing, arithmetic, and geography are valuable aids in obtaining education; but elementary attainments of this kind are little more than varieties of knowledge, which may help us to draw water and hew wood for the world, but leave the mind almost as inelastic as it was before, and give it small new command over its own powers. I have known highly successful men, who have rendered important services as breeders of cattle, greatly respected in their county, who could neither write nor read, who were not uneducated, and whose conversation was delightful. For there are other sources of knowledge and of education than books; and such men, keen of eye and quick of ear, went to the fountain of knowledge in nature, from which books are made, and, dealing with men in the realities of life, learned to use powers within themselves of a yet higher kind than books can evolve. Learning, however, is not to be undervalued, even when obtained from books. Books preserve to us the ideas of men, and of peoples who have perished; record the history of nations, which, like individuals, have to be educated; and bring before us ways of life in distant countries, and aspects of nature which we may never see. Still, it is quite possible for a man to be very learned and yet be uneducated. For knowledge and education are as different from each other as are the structures of a plant and its mode of growth. There may be but little difference in structure between two plants, and yet their ways of life are unlike. Or knowledge may be compared to the structures of our body, and education likened to its functions; and while the differences of structure between man and the tailless apes are unimportant from the point of view of the anatomist, the differences between them in functions of body are very great. Knowledge comes to us from without; education is developed from within. Knowledge may be bought, or be imparted to us by others; but education has to be gained chiefly by our individual labour. Hence, as Richter said, the minds of men in dense communities may grow tall like poplars; but men, like trees, to grow large must be planted far apart. Knowledge may be forgotten; but education is the science or method of life, which expands with the growth of our powers. Knowledge is chiefly useful as material which education is to use for the purposes of life. Education may be gained in acquiring knowledge, but it is usually gained unconsciously, from the common inherited stock of experiences and interests which society interchanges freely. No matter how obtained, the method of its evolution is likely to be forgotten in after years, or it may be confounded with the knowledge through which it came. Yet knowledge, by its narrow, exclusive nature, often makes barriers between those who possess it in different degrees, and by its petty vaingloriousness sometimes degrades its possessor; but education obliterates all distinctions of rank, wealth, and occupation which civilization has made, because it consists in qualities which underlie human intercourse, and make rank, and wealth, and varied labour, conditions of existence.

The forms under which education may be recognized are many, and the same person may be educated in many different ways. Thus, among those who labour with their hands and muscular powers, each muscle of the body is taught to do its special work, and to combine its actions with those of the other muscles; and this kind of education, when perfected, is termed skill. When, from fulness of knowledge of our fellow-creatures, we gain a power of sympathy with their ways of life and thoughts and interests, which enables us to deal pleasantly with them, quite regardless of the circumstances of their lives, this kind of education is named culture. There is, too, the discipline of the mental powers, by which the faculty of reasoning and forming sound judgments is acquired, and such an education is known as ability. Political education is patriotism; religious education is piety; moral education is morality. Now, although skill and ability, morality, patriotism, piety, and so forth, may appear at first sight to have but little in common, they are forms under which education is exhibited with varying conditions of life. They have something of the same relation to each other that the wing of a bat has to the flipper of a whale, or either to the leg of a giraffe or a mole, where the bones are in each case substantially the same, but vary in development with the functions which the fore limb performs. By this analogy I intend to suggest that bodily skill and mental ability are forms of education, which are due to the development in different ways of substantially the same fundamental powers ; and, therefore, if we can discover what it is that the different incarnations of education have in common, we shall arrive at a conception of education which will be true for all countries, all epochs of time, and all needs of life.

If we examine into the nature of skill, and the quality in the surgeon, artist, blacksmith, or sweep, which distinguishes skill from ordinary workmanship, we should say its perfect adaptation of means to ends, or, in a word, its trustworthiness. And thus we discover why the man became skilful. His power is altogether a moral power. His sense of honesty is more delicate than other men's, and so his work is more perfectly elaborated. Honesty dwells with a tribe of kindred virtues, and according to a man's power of drawing into his work courage, truthfulness, sincerity, self-denial, independence, and the like qualities, so will be the degree of skill that grows upon him. Try to conceive of any noble work being attempted by a man with the spirit of a spaniel, or who was always anxious to secure the good will of a man in authority, or who could take in envy or jealousy for companions, or idleness for pastime, or unfaithfulness for his counsellor, and you recognize that such a man would be untrustworthy; neither your character or interests nor your work would be safe in his care, and it would be impossible that such a man could ever do his work with the necessary completeness and calmness to become skilful. Hence I affirm that skill is an index and evidence of morality; and in proportion to a man's moral weakness so is his failure or worthlessness as a workman. And though the world has never been able to successfully teach practical morality, its educational outcome in the form of skill has always been honoured with recognition in pro portion to its rarity.

If we turn from the consideration of skill to ability, we shall see that ability is also an evidence of moral power. Every year about the same number of persons gain the highest places in the university examinations, and are given responsible work in consequence in educating a new generation. The universities have done everything in their power to equip these men for intellectual labour; yet how many men of each year ever do anything for the advancement of learning, or which indicates conspicuous ability? The number is confessedly small, and the insufficiency of recognized intellectual methods to grow able men is a national misfortune. But why the failure? Of course, this necessarily is partly due to the method by which ability is discovered and selected; but is also partly due to the fact that men are often taught so as to learn the greatest number of things in the shortest possible time, not with a view to acquiring the greatest facility in varied practical application of this knowledge, but with a deliberate idea of utilizing it in an examination. This attitude towards students is not the most honest possible; the student, accordingly, rarely does his work with thoroughness. Then many men are merely running an intellectual race for money prizes. They have no concern with anything except the emoluments to which a good place in an examination will open their way; and, when the immediate end is gained, have neither knowledge nor moral stamina to show evidences of intellectual education. Now, unless a man is dissatisfied with an imperfect training, and strives from love of truth to perfect his knowledge in other ways than recognized methods may offer, unless he has the courage to break away from traditions and seek after usefulness, he is not likely to be in a position to show ability in the subjects in which he has been trained. Hence ability comes, like skill, to be very much a matter of moral power, and it may be doubted whether any important series of discoveries was ever made by mere dexterity of intellect. For it is only by the faithful pursuit of truth, by courage to grapple with it under whatever form it may come, by faithfulness for the subject from which the mind can be turned by no accidents, by sympathy for the labours of other seekers after truth which appreciates and profits by good work done, and offers our own results as stepping-stones for coming labourers, that the conquests of the human mind have been achieved. If the intellectual labourer is to rise above the level of a mechanical craftsman, he must at least reach this standard. And if he is to teach, it is impossible that he can train boys or men in the higher moral virtues unless he exercises these virtues daily in research.

It appears, then, that unusual excellence, either physical or mental, is manifested by means of keener and stronger moral perceptions than are commonly met with, so that we arrive at the conclusion that education, no matter how carried on, is valuable in proportion as it disciplines and develops the moral faculties. This conclusion brings us back to the common idea which speaks of education as our bringing up; and recalls the wisdom of William of Wyckham, who gave to his scholars the motto, "Manners maketh Man." History, indeed, teaches us that the crown and flower of life has always been courteous, just, and fearless doing of whatever had to be done; and such life is the inevitable law of existence for those who have been well educated. If we reflect on the events in history which have moved nations and roused the passions or enthusiasm of mankind, we shall find that they have never been any technical perfection of workmanship, though all mankind is to profit by such skill; nor has it been invention or discovery or ordinary evidences of ability, though these have brought immeasurable pleasures and profit to all peoples; but simple questions of moral right or wrong, of duty performed or neglected, such as reflects the education of the family fireside, and needs no laborious training of body or mind to enlist a people's sympathies. Or, if we think of the sense of duties which causes the heads of families to labour ceaselessly in millions of homes throughout the world, we shall perhaps more easily realize how mighty is the moral force by which we are educated and moved, and how little influenced it is by country, condition of life, sex, or age.

It is manifest, then, that the moral qualities are not only the framework of society by which peoples are held together in nations, but their exhibition in national life is the condition of all healthy international relations between governments. And whatever the pursuits of the people may be, all true national prosperity, like the true happiness of the individual, can only grow from an exalted spirit of honour which will tolerate no obstacles in its path.

From this view of the nature of education, it follows that there is a unity in life from early childhood to old age, which is not always realized. It may be true that the convictions of youth can rarely have the iron strength that comes in mature life; it may be true that, as years go on, we all rise on stepping-stones of our dead selves to higher things; but it is also true that the moral ends of life are never varied, and are only followed more clearly in after years when the limits of attainment are discovered, and energies are concentrated on the work that is still possible. History shows the same process extending through centuries, in the aggregate life of a nation, that we may notice now in the maturing of an individual life; for nature has appointed no period for education. It begins in earliest childhood, ends only in death, and survives death itself in its effects on the after-time.

Just as we urged at the outset that we must distinguish between the means and the end, and clearly separate knowledge from education, so we must recognize that mere belief in the moral principles by which education is recognized will give no one a title to be named educated. The ten commandments are frequently recited in the morning, while the neighbour's apple tree is climbed in the afternoon;

and though most people declare that we should love our neighbour as ourself, it is amazing to think how little self-love there must be in the world, when we see the amount of love which the neighbour is offered. We may learn by rote best moral precepts and yet be immoral, because we only know what is right, and have not been educated in the practice of morality. There is, therefore, no short cut to education, and he who enters life encounters education and knowledge as Hercules encountered Virtue and Vice, and a choice like his must be made. The teaching of Virtue was that if Hercules would be able in body, he must train his body to obey discretion, and exercise it with labours and sweats; and after more than two thousand years we have no better counsel to offer to Englishmen in the name of education than these thoughts, which Xenophon gives from the mouth of Socrates.

If we are now clear as to the nature of education, we may glance at some of the steps by which it is acquired. There can be no doubt about the extreme importance of earliest influences on a child, and at this period of life there is perhaps more in common in the bringing up of people under different social conditions than might at first appear, with, it may be, a balance of advantages not altogether against the poor man's child. I mean that in the wealthier classes children are to a large extent consigned to the care of nurses, who may faithfully discharge their trust, but can rarely possess the firmness or the discriminating affection which is natural to parental government in a family; while parents who are not educated by the constant hourly or daily study of children, are not in a position to guide or develop the sympathies or strengthen the moral tendencies, which have been partly inherited from them, but are largely subject to the influences of the nursery. It may be said, without the least reflection on an intelligent class of servants, that the bringing up of many nurses has not always been so good in its moral atmosphere as parents in the intellectual classes would desire for their own children; yet these young women become the guides and friends of the young generation, and mould their thoughts and *morale*. They may teach a sound morality, but it is often with a severe formality which inspires revolt from its control, and, as they are rarely sufficiently educated to do more, dole out the learning of the Sunday school in maxims of right or wrong, for validity of which they can render no intelligent reasons. The reasoning powers of the child may thus become cramped or arrested; for after its first difficulties are evaded or dishonestly met, the moral sense sometimes loses its natural keenness, and the child readily takes up the teaching that its own heart is deceitful above all things and desperately wicked, when it has merely been educated in ways which are not those of the highest virtue. I doubt whether parents often realize how the seed thus sown in a young child's life, by developing fear, by engendering concealment, by repressing inquiry, by making it tolerant of falsehood, grows with succeeding years so as often to emasculate the mature character. Even in some important matters of knowledge the nurse may have an unsuspected influence. It is well known that many persons throughout life have a difficulty in spelling their own language, and of late years some enthusiasts have assured us that the difficulty is inherent in English orthography, which they would like to reform. Experience leads me to believe that though spelling may be learned by eye, it is usually acquired by ear, and the pronunciation of the nurse, who may in some families be changed, often gives an uncertain or slipshod value to sounds, which ruins the child's ear for sound, and makes accurate spelling more difficult. There is no doubt that with educated pronunciation the difficulties in spelling any language are reduced to a minimum, for the sound of a word may be copied as exactly as a note in music. Hence, if children are to be entrusted to servants, the seriousness of the trust is worth parental attention, both for what is lost and for what is gained; and a servant who successfully develops and educates a young life to school age is worthy of no ordinary consideration in a home. In saying that the poorer children were at no serious disadvantage, I had in my mind not so much the fact that the wives of labourers and artisans have been in many cases servants systematically trained in various household duties, and therefore more or less educated in house-work and care of children, as the direct relation that inevitably exists in poorer homes between parent and child, and remains unchanged as long as the child is under the same roof. And teaching given under the influence of parental affection would, I conceive, be wiser teaching than the same person could have given to other children as their nurse. In any case, the child is likely to have less control, better opportunities for exercising powers of observation, freer communication with other children, and other conditions of life which are calculated to start the reasoning powers on a sound basis, and foster education. The nature of home-influence in any rank of life is well expressed in the popular belief that remarkable men often have remarkable mothers: but the reason for this relation is perhaps exemplified in the Scandinavian stories, which invariably make "boots," the youngest member of a family, its most gifted representative. If a mother gives the strength of her life to the care of her children, it would be remarkable if those children were to show no evidences of such advantages; and the Scandinavian idea expresses the fact that the youngest child has no competitor in parental attention, receives a better home-training than the elder children, and is indulged with greater freedom from control. I dwell on freedom from control as calculated to foster originality and mental independence; and although such qualities will certainly increase the labours of those charged with bringing a child up, the tendencies thus originated are likely, under the moral discipline of the home, to strengthen the child's character and have good fruit. Nothing is more certain to enervate and enfeeble than surrounding a child with a palisade of cautions. The only moral entrenchments which are effective are those educational defences thrown up from within.

In youth we have another phase of education. When a child is placed at school during the most receptive years of life, it is more certain to acquire knowledge than education. The modern school is often too ambitious. It is like a house-furnisher who undertakes in an incredibly brief period to see that a house is supplied with everything that its occupants can require for use or luxury. The number of subjects taught, even in the best schools, is far too large for complete mastery of any of them by the average pupil. This is not the fault of boy or girl, so much as of the want of judgment and greed of parents, and the competition in attractions between schoolmasters and school-governors. The chief duties of youth at school are to grow body and mind which will last through the duties of manhood and womanhood; and in the case of public schools, successful development depends not less upon work of a boy's own choosing than upon that routine of the college or school which brings him into contact with the minds of his masters. There is a facility of intercommunication between young people which enables them to learn many things best from each other; for experience, ideas, learning, and knowledge of the meanings of words, are all similar among young people of similar age, so that the overflowing stores of young minds are freely exchanged. This influence, which is at once individual and collective, has always seemed to me one of the best things which a boy gets at a public school. Its value is in proportion to the size and tone of the school. The masters may be nominally in *loco parentis*, but cannot exhibit the tenderer and domestic side of parental influence, though the birch may be banished; and the moral tone of a school, though taking a keynote from the head master, is essentially the boys' power of understanding what is right, and enforcing the right by moral means. This aggregate morality has been brought from hundreds of homes, and represents more or less affectionate strivings of as many households, and becomes organized by school life. I should place second in a boy's mental outfit the part he takes in public games

—football, cricket, fives, swimming—not only because such pursuits train his body into healthy strength, but much more because the moral virtues of acting in concert are thus learned, together with decision, endurance, boldness, courtesy, and, in fact, all the considerations which in after life will be of most importance in dealings with men or women. These virtues can in no other way be practised so well, and they exhibit in tangible form evidence that the time given to physical education is not taken from more important studies. Third, comes school-work. The subject of a curriculum will always present some difficulties, but when we think of the schools of the Greeks we do not find them neglecting their own language, and teaching infant Athenians to make verses in a dead language as a means for securing powerful command of Greek. The Greek mind was great because it used knowledge as a means to education, by going straight to nature. Aristotle dissected so that his researches are still esteemed; and the reasoning of Socrates, which was in his own language, has admirers yet. If we would emulate the Greek mind, we must work with the methods it used. In the Middle Ages it was not unnatural to teach Latin and Greek, because the little knowledge which was then available in law or medicine or literature was only to be reached in that way. But for long ages now the intellectual wealth circulating in our own language, and languages of other modern peoples, has been infinitely more important to Englishmen ; to say nothing of the English tongue, which, whether used with classical precision or with ignorant indifference, is the organ of lifelong expression for our endeavours and education. Hence, by the time middle life is reached, a large part of school-learning has in most cases usually disappeared, without leaving in its stead any education commensurate with the intellectual labour gone through in making the barren acquisition. With most people the conditions of school life do not entirely remove a child from the father's home; but the working man's child gets no such games, no such moral and physical development, no such mutual trust of his schoolfellows as the public-school boy; and, unfortunately, the working man, having never known these advantages, is unaware of his children's loss, and probably rather approves of their privation, accounting the school-games idleness rather than the highest gain. This difference in *morale* in the school life is the bottom of the fast-closing gulf which divides the working class from the better educated employing class. And accordingly, in the mistaken pursuit of knowledge, working men often miss education, and learn their morality in empirical *formulæ*, or laws, instead of acquiring it in a living way by practical relations with their fellows. Probably the teaching now given in Board Schools under the provisions of a beneficent Act of Parliament is far from being the best possible, either as meeting the wants of the individual or the wants of the nation, though infinitely better than no teaching at all.

It may be an impossible dream, but one that I think worth making practical, that we should teach our youth the general principles of those aspects of nature which form the staple of their daily experiences; and so much, at least, of the structure and functions of the body as would enable them to appreciate the advantage of care and reverence for living machinery which is to minister to the labour of life and to its enjoyment. And when you think of the almost professional nature of the education given in the Middle Ages in our universities, it seems to me a mistake for those who can have no opportunities for higher education to be deprived of teaching which would help them to increased interest in their daily work. The boy turned out from school to become an agricultural labourer knows nothing of the nature and properties of soils, or the life and distribution of trees, cultivated plants, or animals, in working among which life is to be passed. In manufacturing districts, in the same way, the boy commences work without any definite ideas of the nature and properties of steam, or the properties and history of silk, wool, cotton, iron, or leather. The young worker in wood knows nothing of the forest industries on which his own depends, or of the aspect, distribution, or properties of the timber trees on which his skill is to be developed. Such knowledge would not only impart a greater interest to each man's daily labour, but would tend to cause the work to be more intelligently performed. And now that labour has to compete with machinery, as well as to work it, labour must establish its superiority by intelligence and by skill. School-board education is too oblivious to the conditions of a working man's life, too mechanical, too much severed from the ends to which it should be a means.

When school-days are over, and body and mind begin to show some promise of the powers and strength with which they will wield the moral force which has grown or been nurtured within them, there comes the aspect of practical education in which a choice of pursuit is made that is to last through life. This choice is commonly difficult. Parents have hopes and make efforts according to their knowledge and means to start children in ways that are to bring them prosperity and happiness; but few can believe that their own success, or the success which the children are to emulate, has been gained by the training of moral powers which make a life noble, no matter what its pursuits may be; and that the prosperity they admire or glory in is the reward of humble duties faithfully, thoughtfully performed, with ceaseless vigilance and labour. And this field, no matter how restricted, can rarely be incapable of absorbing the whole of any man's energies, if he honestly seeks to pour the strength of his life unreservedly into his work. When a man has the courage to do this, his work becomes ennobled. If imagination and thought dwell with him, then inventions and art are manifested, and give the most ordinary pursuits a value which creates a sense of new needs in mankind.

As a preparation for this practical work, universities and higher schools offer help to those who can afford the time for such study. I should be disposed to say that the education obtained at our old universities is the best which it is possible to get; not because of the subjects taught, though these are varied, or from the learning and teaching power of the professors, though these are usually of the highest kind; but because of the social life and moral atmosphere in which the student moves. Not only are the men there, to a large extent, sons of men who have an inheritance of honourable traditions, *noblesse oblige*, who have cared for their country, and have served it in some way, but they are at an age when hope is insurgent, and when generous sympathies which the public school has fostered flash ardently along the problems of life and life's pursuits, as these are surveyed from the quiet citadel of the university. Here a young man may learn fearlessly to use his moral strength, and find that the learning of the university is only valuable as it gives him new ways in which his human culture may strive. When he leaves the university after obtaining some distinction in her schools, not so much the subtleties of languages, or the genius of those who wrote in them, will help him in the labour of coming years: it will not be command of higher mathematical analysis that facilitates his toil in administrative work; but above all learned studies there will ever come to the front the moral discipline of the body in manly sports, and the moral discipline of the mind gained by contact with many minds, which fitly prepare it for such worldly relations as make up the groundwork of life's experience. I would not be thought to undervalue any training of the mental powers; far less to suggest that idleness may enjoy the fruits of toil. Idleness in the long run can enjoy nothing.

But the forms of mental development are more varied than the methods ordained by the universities for mental discipline. Not once or twice in university story has it happened that men at the head of the river have been at the head of the schools. And not once or twice has it happened that men who have gained the honours for which they have striven have done so at the sacrifice of health which many years of subsequent rest has not restored. In my time there used to be a saying at Cambridge that about a hundred possible senior wranglers come to Cambridge every year, but only one survives. The truth is that there is too much competition for distinction for the higher faculties to have breathing-time. Too much of a successful start in life in some professions is made to depend on high places in the schools for men not to be tempted to speculate with their strength, and squander in three years of intellectual gambling energy which, used more wisely, might have carried them through life with more than ordinary usefulness, and with enduring honour. And, after all, it does not follow that the man who at two or three and twenty has proved himself dexterous and learned in the subjects of his studies, will be equally eminent at thirty or forty in studies of another kind; or that he will then combine with fine mental discipline the patience, decision, courtesy, firmness, calmness, boldness, and the many attributes of a well-trained life which the world's business demands. University honours are like a lottery to the individual, as well as to the world which trusts in them. This will be inevitable so long as it is imagined that ability can be detected and satisfactorily measured by examinations. Examinations are always a race against time, and in no one of the learned professions is there any need for the same turning out of work, well done or ill done, against time. Quantity is not so important as quality. Examinations, to have any serious value, should, it seems to me, be conducted by the professor who teaches, as professors' examinations were in the old days at universities; for such a method ensures a certain contact between the minds of teacher and student. And it is more important for the world's wants that the student should be trained in the best methods and best knowledge, and then left to demonstrate any ability he may possess by using these methods and knowledge in some practical work, or in research, than that he should be distinguished by any university title. Ability would, perhaps, be more easily recognized if university degrees did not exist, for it would then be judged by what it has accomplished in administration, or in adding to the store of human possessions. Perhaps in the near future London will demand for itself a teaching university freed from the present system of examinations, in which the mercantile and manufacturing, engineering, agricultural, and mining industries of the country will receive consideration, side by side with the newer applied sciences and arts, with our own language, and other languages, and the older studies which other universities have especially cultivated. Such a university might provide trained ability in every intellectual pursuit which goes to make up national life, if it placed practical usefulness and the advancement of learning before the present crude tests for knowledge.

For the great mass of men, however, any such university life will always be impossible. The youth who is drafted off to clerkly duties may indeed, by means of evening lectures, obtain a higher education at colleges in London and some large towns. But, except in apprenticeship, now less general than formerly, there is little or no systematic training for the artisan. But the apprenticeship, or its equivalent probationary work, is the time in which the skill is to be acquired with which the working man is to serve the world. The working man, having no capital beyond small necessary savings, has no choice but labour, and must usually take work wherever it offers. Yet perhaps the fact that he often systematically declines it, and month after month subsists in the direst poverty, on strike against real or imaginary grievances, may be taken as evidence of that moral stamina which, when put into productive labour, has done much to make the reputation of British industries. It is this quality of perseverance as long as strength lasts, in the endeavour to do what is believed to be right, that expresses the educational training, and defines the character of the British artisan. His training is in a limited compass; as a rule, there is no play for fancy in the section of a trade at which his bread must be earned. But his own work must be accurate, and finished up to a standard, so as to be adapted to the other parts of the industry to which it belongs. His intellectual efforts have, therefore, always moral ends in view, which pervade his life with some intensity. Even in tending a machine which works accurately, there is a training in accuracy which is none the less valuable because unconscious.

There is urgent need not only for better scientific training of workers in every department of our national industries, but especially for wider knowledge of their mutual dependance, and the conditions of prosperity in trade. And probably no investment which employers of labour could make would yield so rich a return as the diffusion of this knowledge, both among manufacturers and those who work for them; for it would tend to prevent speculative over-production of unsaleable goods, and prevent strikes against the inevitable scarcity of money for payment of wages. Most people learn that lowness of price is not necessarily cheapness; and it rests with the mass of the people to help the nation to prosperity by deliberately preferring in their purchases work that is evidence of honest thought in the employer and of skill in the artisan. If utility and durability are considered first, art is sure to graft itself on to excellent work well paid for. But if people are so inexperienced or uneducated that they cannot discriminate good work, then they must pay for their ignorance by having to buy often, with the certainty that manufacturer and workman are both degraded morally in bringing the quality of their productions down to meet the uneducated demand, which is conscious of no standard of value but lowness in price. In the slow diffusion of information by newspapers and booksellers, improvement in the ideas of the buyer is sure to be brought about; but in the mean time the hand of the workman loses its cunning, trades leave our shores, and we find ourselves importing goods of the higher quality that were once regarded as peculiarly British. And I can see no remedy for this ebbing of morality out of trade except that every workman should be educated during his apprenticeship years in the political economy of his own trade, and educated so far as possible in later years in the science of commerce. Education of this kind would present no serious difficulties to an intelligent co-operation of workmen and manufacturers seeking their own interest; and they would find therein a less fluctuating condition of national prosperity, and greater individual happiness. I can say nothing concerning the education that every human being gains in the lifelong pursuit of our multitudinous several industries. We become divided by them, as mankind has always been, into labourers, artisans, tradesmen, merchants, manufacturers, domestic servants, public servants, professional advisers, educational teachers, artists, and many others; but all pursuits need similar thoroughness of training, a like appreciation of duties to be discharged, and the same morality for their several kinds of work. And in so far as the morality is the same, there is an obliteration of the severity of social distinctions, and there shines through people, thus widely severed, the same humanity. For the uneducated, the differences in conditions of material life make the world appear a hard one, in which inexorable laws, binding mankind together, shut out from experience the liberty, equality, fraternity, for which dim longings sometimes seethe within them, in days when hunger gnaws and industry is at a standstill. But for the man whose work in any way has brought into free exercise his inborn moral life, happiness is independent of his industrial pursuits, for the conditions of happiness are the same in them all. And when he contemplates the world from this human point of view, he enjoys liberty—liberty which is limited only by power to conceive of it and take it; he is aware of equality, which knows no boundary but his power to share it; and his fraternity can only cease when men have joys and sorrows with which he has no sympathy. Men are not born equal, but unequal. Although it has been said beautifully that we bring nothing into the world, and can take nothing out of it, yet some bring voices which enchant a generation; others bring fingers whose dexterity lives in their works—a glorious heritage for all time ; and others bring originality which, in small or large changes, alters conditions of existence and augments its productiveness in a town or for a continent. And these marvellous inequalities are but a key to the practically infinite diversity among men, which existing methods of instruction endeavour to annihilate by ignoring. There is no equality, because there is inheritance of the virtues and culture of parents, as well as of their vices and weakness in body and mind, which may endure to the third and fourth generation. This inheritance is capable in after years of being negotiated, and represents a money value or the reverse, of which no heritor can entirely set himself free. And the pursuits of men, their pleasures and studies, all augment the inequality. And just as there is no equality, so there is no liberty, since man is ruled by laws of nature which exterminate him if its mandates are neglected. The human laws are few which punish with death. Nature slaughters without mercy if she is not worshipped in simplicity and truth. We perhaps veil our eyes with the name of some disease; but diseases are but the writs which Nature serves upon us, when we attempt to live by other laws than she has made. There is no liberty but liberty to see the path for life's journey, and to feel the goads with which Nature drives us in her ways. Our liberty is in proportion to the smallness of our demands in life; if we would drain the flagon of existence, then we must enter into a self-made slavery to nature, that can know of no relaxation till the finger of death brings liberty. It is not true that there is no fraternity. As the great Eastern Teacher says, we are bound together by our sorrows, by sufferings and common pain, and by sin. The affections are a common bond to all men; and the moral life is the common language which obliterates differences of custom and speech, and enables the traveller to dwell with strange people. While love and jealousy, avarice and cruelty, endure, there is sure to be fraternity. And education may yet do something to give us sweeter manners which shall permit an outward expression for the gentle feelings within. Fraternity, equality, liberty, are fermenting ideas which form an inevitable part of the education of young men. They appeal to heroic sympathies natural to the warm heart of youth, and to its inexperience. But with life's evolution these aspirations take a practical form. Fraternal feelings develop themselves into the education of married life, and duties which devolve on the heads of a family; ideas of equality find their practical outcome in pursuit of the daily work which in some form comes to the hands of all; while aspirations for liberty express themselves in patriotic love of country, in which political institutions enable all to share. These three conditions of existence govern the larger part of the education of manhood and maturity. Marriage, work, and political activity are not merely the concentration and outcome in practical form of all phases of early education, and ends for which that education is gained, but the conditions of human development, when the faculties have been trained to virile strength; and under them alone can the full harvest of life be gathered. They make life worth living because they give it unity, and because they add to the receptive mental attitude of immaturity the conditions under which what has been acquired may be imparted and developed as means to personal happiness, which link the individual with the community. They are the garden of life in which the moral evolution, which has been nurtured hitherto by familiar guardians, becomes transferred from the family to the guardianship of the community, and is henceforth rooted for life, and free to grow according to its strength.

If I place marriage first in this tripod of life's higher education, it is because it is the condition of social organization, the key to most political problems, and a main factor in stimulating work. It makes the most natural classification of mankind. For the unmarried are but members of families, owing their chief duties to their own family heads; they are patronized by the heads of other families, and for the most part they exploit society. They rarely realize, because they cannot share, the intensity of the obligations which make the family the unit of social and political activity. With marriage, however, independence comes; inevitable to the founding of a family, because new duties unfold themselves daily. These duties are substantially the same in kind, no matter what the social status of the family may be; for an income of £20 a year or one of £200,000 a year can make no variation in the kinds of duties we owe to our families or the families of our neighbours. And it is these duties which preserve even the most barbarous and degraded of mankind from social chaos. And the right to perform these duties becomes a species of property which no family can relinquish without loss of honour, and the possession of which gives to all other kinds of property a new and personal value. The essentially indissoluble bond of marriage gives a practical definiteness of purpose to life which governs all its circumstances. A great judge considered that people become good husbands and wives from the necessity of remaining husbands and wives. Without accepting this cynical dictum, we may recognize the education in mutual restraint, and in combined pursuit of objects of interest, which the conditions of married life impose on all as the price of happiness. And it is not too much to say that in no other way can man or woman develop their faculties so effectively as in marriage. It is not merely that two individuals come to blend their diverse lives into harmony more or less complete, or that their individual energy becomes multiplied by being reinforced with other thoughts and feelings, but that the two lives thus blended and circumstanced enable the man and woman to sympathize with and comprehend the relations of all other married persons; so that society, so far as they are concerned, ceases to be a concourse of individuals, and becomes organized. It is the first step towards realizing the moral aspirations in social life. But when to this condition are superadded the relations of parent and child, and administration of a household, the sphere of personal education is enlarged with duties and responsibilities, which at the same time draw closer the bonds of union between your own family and the many other families which form the nation. By these obligations the family stakes its prosperity on the prosperity of the community; and the community intervenes to watch over the family in education, health, and all matters in which happiness can be advanced by united action. Thus the faculties named moral, which education, faithfully performed, trains into activity, strength, and co-ordinated action, find unlimited scope in the tender duties of home and fraternal obligations to which home duties lead up.

But with this evolution goes on the search after equality, popularly termed "finding a man's level," though this level is as varied in relative elevation as the surface of the earth. On the needs of the family usually depends much of a man's industrial activity; and, quite independent of the kind of work which may engage him, his labour must vary with his physical strength, intellectual activity, and moral energy. We have already seen to how large an extent happiness is independent of wealth; but since wealth is the only standard of value with which the mass of the people are familiar, it is esteemed the popular test of excellence by the imperfectly educated. There is probably no more degraded mental condition than is implied in measuring men by money, for the best things that life offers are not purchasable. The money paid for services is a mere matter of supply and demand, so that the rate of remuneration or profit only testifies that those having money pay freely for things which they desire, which are not easily produced. There is no greater excellence in a rare thing than in a common thing, in a new plant than in a familiar blossom, and even diamonds decrease in value as the supply becomes larger. But there is a natural and not unwholesome desire after money, because there is an education in again parting with it. But after all, when we consider money as the medium of exchange, and as affecting the producer of wealth, we find that the inequalities in its distribution are practically unimportant except in relation to the gratification of ambitions. The purchasing power of money varies with the individual purchaser, and is governed by education; and although the severity of the struggle for existence is felt bitterly where small earnings make thrift impossible, yet for the mass of people the pleasures to be purchased by varied earnings differ only in degree, and not in kind, and by far the richer part of life's enjoyment lies outside the purchasable products of life's industrial energies. In no other aspect of life does want of organization cause such waste of energy as in our daily labours. This is because it is impossible for the individual to discover what are the real wants of the community or nation. Such knowledge might easily be obtained, but has never been systematically collected and arranged; and the consequence is periodic over-production by the manufacturer, unremunerative cultivation by the agriculturalist, and strikes against inevitable resultant reduction of wages by the labourer, with all the attendant evils of fluctuating misery and prosperity for all classes of the people, all the more difficult to endure calmly because no individual by his own efforts can remove depression of trade. Hence it is in national industry that education is most urgently required. It is not merely technical education that will help us, because that is only a necessary supplement to the growing decadence of education by apprenticeship. But modern facilities for distributing the products of labour have given to all industries an international as well as a national importance. And there are few kinds of produce, either raw or manufactured, no matter whence they come, which do not ensure some demand when once their existence is known.

The international aspect of industries governs the daily activities of the mass of mankind ; and on the Government devolves the important duty of collecting and distributing information as to the ways in which the productive industries of each nation are influenced by the demand of other nations for their merchandise—a duty already in part performed by consuls and secretaries of legation in countries in which they reside. And when to this information we add statistics showing the growth of consuming and producing power in relation to increase in population, applications of new scientific processes to old industries, and competition in commerce, through a number of years, we are able to judge of the quantity that we can buy or sell of each article, and of the price that may be fairly or wisely paid for its production. Yet, though this knowledge is the fundamental condition of commerce, and an important factor in civilization, it is not organized by governments or universities; and merchants and manufacturers each acquire independently what information they may, as the only guarantee of safety in trade, or of success and fortune. But the fundamental conditions of national prosperity are hardly matters which the community can contentedly leave to chance or the accidents of commercial competition. After this branch of geographical knowledge has been made accessible by the resources of the State and the labours of professors, there will still remain room enough for legitimate enterprise in trade. It is significant that, although the directors of many industries are often united into Chambers of Commerce or Employers' Trades Unions, the scope of this association is generally protection of trade that already exists rather than education and organization of traders, out of which alone improvement of trade can grow. The first step to trading prosperity is, first, federation of the merchants and employers in each industry in a nation; and secondly, international federation, so that the conditions of supply and demand for raw material and manufactured produce may be brought into daily telegraphic communication all over the world. Of course, there are many whose gains would be curtailed in this way, and by whom such diffusion of knowledge would be regarded for a time as spoliation; but it would substitute co-operation for blind competition, and place industry upon a basis of scientific knowledge and morality instead of speculation; for speculation is but gambling, and afflicts the country with waves of prosperity and misery. The conditions of national prosperity are due, in the first place, to the varied bounty of nature in successive years in different parts of the earth, which determines the increase of capital in relation to population, as well as the production of merchandise in relation to the raw produce which results from sunshine and rain. The community as a whole, therefore, has a right to such protection as knowledge can give against the rapacity of man as a sequel to the fickleness of nature, and it is altogether unreasonable that influences which affect large parts of the earth's surface and the masses of its populations should be for the benefit of the bold adventurers of commerce, who are astute enough to discern afar off and capture the prize of exceptional increase which is nature's gift to mankind.

The discoveries of scientific men have created or modified all modern industries. And scientific men usually give their life's work freely for the benefit of mankind, often engaging in pursuits which are drudgery to gain leisure for the advancement of learning. They seek wealth, not for themselves, but for their fellow-men. If the incomes of the professors in British colleges, who are engaged in creating knowledge, were tabulated, the statement would supply a striking commentary on the doctrine that the means are not always commensurate with the results which they produce. Yet, though the scientific man, like the true artist, is prepared sometimes to eat bread and drink water for the sake of his work, there comes an unsought return from the community, in the concession of an influence and power which is becoming akin to that which in former ages was wielded by religious teachers. Like that influence, the growing regard for science is due to the moral courage and independence which lead its cultivators to renounce the great prizes of life for the sake of the pursuit of truth and enlightenment of mankind; and would vanish if scientific men became traders and habitually made fortunes out of their discoveries, or sought after honours. The labour of scientific investigators, carried on without haste, without rest, among the phenomena of nature and human life, is its own reward; and probably no one could be found who, having known the joy and calm with which it endows life, would wish to barter these substantial collateral pleasures for the uncertain enjoyments which reward those who engage in industries which yield wealth, and results which can be appreciated by a larger number of men. But the pursuit of science is happily not inconsistent with devotion to great industries with which it is so closely linked, or with public life; and many distinguished cultivators of science are found among manufacturers and politicians—educated men who look beyond the facts which are their daily concern, to the methods of nature's work. The chief peril which scientific education has to encounter is the occasional advent among its workers of men of towering personality, who alloy science with their own individuality, and who endeavour to set up, each in his little realm, a mild kind of papal rule which ensures the domination of his own ideas in the science of the time. This kind of political activity is a violation of conditions of national scientific progress, and on that account alone we might desire that men who are thus gifted should rather serve their country in the field of practical politics, which offers full scope for such ability.

Politics involve the highest education. There is no higher duty than the duty we owe to our country, which gives us an inheritance of political liberties. It is a noble ambition to exercise the privileges of political life, by which we have an indirect but real part in the government of the nation. It is not merely desirable to possess the right to take part in electing representatives on local boards, municipal councils, and in the imperial parliament, but the exercise of this right is a duty which we owe to our country, which no man can honestly shrink from performing. It is only when great public questions stir the heart of the country, and sympathies lead us into united action, that we recognize that political activity is the practical realization of fraternity. Party politics have no necessary connection with politics, any more than the relations of Cain and Abel are necessary to a conception of fraternity. Politics consists essentially in the whole nation combining to secure prosperity and honour for the individuals, on the one hand; and, on the other hand, for the nationality in its international relations. These are the ends which our votes are given to support. But the human mind is so constituted that, with different surroundings, with education and age, the point of view of what is desirable in politics changes. And the questions in politics are much like those involved in the parable of the lost sheep. We may well believe that some shepherds would leave the ninety-nine sheep uncared for, and seek for the one that was lost; while other shepherds would find their chief duty in watching over the ninety-nine. And this difference is the basis of party government. There is one type of mind which rejoices in existence in whatever form it comes, which receives with thankfulness all liberties which past ages have handed on, and cherishes the memory of national honour, and is slow to believe that changes may be for the better. I need not say that this type is named Conservative. There is, however, another mental type, in which hope is more insurgent, which looks rather to the future than to the past; which views the present with discontent, and believes that change is the condition of progress, and is always seeking for the missing liberty. And this type we term Radical. Antagonistic as these opposing camps seem to be, the Radical propaganda of to-day becomes, when accepted and passed into law, the Conservative inheritance of to-morrow. Most things which Radicalism would sweep away and Conservatism conserve were the Radical victories of times past. And one great advantage of our political government is that no great change can be made in any matter that affects the majority of the people until the nation has been so far educated in considering it, that their convictions are expressed in favour of change. Some changes are inevitable and easily foreseen. We have merely to inform ourselves of the directions in which changes in our constitution or national policy have taken place in the past, to see the directions in which development of national opinion will take place in the future, so as to bring new public questions within the range of practical politics. But, on the other hand, we need the evidence of history to inform us of the questions on which no change can be accepted without peril to feelings of public confidence and personal peace, which are the conditions of prosperity. This power to appreciate conditions which govern the political convictions of the masses of men is the first germ of statesmanship, and its acquisition is the beginning of political education. History teaches us much; but history records events rather than accounts for them, and we need some knowledge of natural history if we would study the life of a nation as though it were a composite individual, which has its laws of development, of healthy activity, of disease, and of failing vitality. The larger questions of politics grow out of the physical organization and habits of mankind considered as an animal species, existing subject to the natural laws by which the earth is governed. And till our British peoples are studied from this point of view of the zoologist and physiologist, and with knowledge of the laws of life which are exemplified by the lower forms of creation, we shall always be attaching more weight to accidental circumstances and intellectual convictions in politics than is consistent with the universal action of the laws of nature, on the one hand, and the varying circumstances which, on the other hand, affect the population in large portions of the country. So I venture to say that politics is man's endeavour to understand the natural history of mankind, and it only differs from the politics of lower zoological forms in such matters as exalt man above the other life with which he shares the earth. And whereas Nature, left to herself, works slowly in determining the adaptability and variability of species, in bringing about their relations to each other, in varying their distribution on the earth, in giving them dominance over other forms of life, or in exterminating them, man by political activity attempts to aid Nature, and by conscious, thoughtful effort to assist in the evolution of such life as is consistent with our organization and conditions of existence. Thus regarded, politics have definite laws, easily understood, and become a noble science, in which the contentions of political parties are means of giving useful effect to convictions which are becoming universal; and the individuality of politicians is the method of making manifest convictions which are held by a minority.

The education of life, as shown in the revolving panorama of existence, should now be vivid enough for us to judge how far the educational equipment given to us in youth and early manhood is the most suitable provision with which to undertake the duties of life. We have seen that there is essentially the same end in education, the same moral discipline, no matter what the means may be which are used to attain it. But if I were asked how this work may be best begun, I should reply that training through the medium of our physical senses and sensory organs seems to me to claim the first consideration, not only because all knowledge of physical truths, as distinguished from belief, is gained through the senses, but because it is only by accurate training of the senses that we learn to give expression to knowledge and mental power. If I were planning a curriculum which should in principle be applicable to all people and in all schools, I should strive to impart powers of expression, and should require first the discipline of language. English words need to be used with the same accurate adjustment as bolts, screws, wheels, valves, and other components of an aggregate machine which have to be fitted together. And the man or woman who has the power of giving perfectly defined and accurate expression and utterance in language to emotions, convictions, or knowledge has taken the first step in the necessary education of life. I regard drawing as the second essential of sensory education. It is a kind of international intellectual shorthand, which is capable of being written and read independent of nationality; and is capable of giving expression to large classes of acts and ideas which cannot be put in writing or into speech. The third essential of education I regard as music, which is to the ear what drawing is to the eye. The discipline of accuracy in sound is necessary to accuracy in speech; but until sounds can be combined accurately, and music read and written as freely as the English tongue, a man is manifestly at a great disadvantage in having an inarticulate life. The emotions exist which demand musical expression, but most of us in this matter are dumb, or content to repeat like parrots the musical ideas in familiar compositions, because they are the nearest approach to an utterance which for want of adequate education is inexpressible. These three methods of discipline for the tongue, finger, eye, and ear, are but the education of expression, without which it is impossible to impart efficiently the fruits of any higher mental discipline. But to them I would add three other forms of elementary training, without which the faculties have no reasonable chance of development. First, there is the discipline of observation of nature, by which accurate knowledge of the heavens, earth, and life around us is alone to be obtained; secondly, there is discipline of the imagination, or the art of organizing facts; and, finally, there is the mathematical art of numbers, which involves the discipline of reasoning in its most effective and practical forms. This is not a very extravagant total of learning; but it embraces elements which admit of almost indefinite expansion. It has few points of contact with any curriculum of existing institutions, yet, in so far as it differs from such as now obtains, the difference is due to evolution in the human mind and development of educational resources, which has taken place gradually, and has not generally been regarded. The existing curriculum is the feeble survival of the methods of the Middle Ages, though the needs for those methods can never reappear. If any one should say he is content with such results as have been handed down, the reply is, they are good, but at the price of an enormous and needless consumption of individual energy; and they are bad so far as they are not the key to the existing stores of knowledge and products of intellectual activity.

In some respects the education of women is better than that of men. Women have always attached great importance to those subjects which I term the instruments of expression. Language, art, and music occupy a large space in education of the middle-class girl and young woman, and the powers of observation are rarely entirely neglected, so that a knowledge of botany and physical geography at least is generally acquired. And if the results of woman's education have not greatly impressed mankind with the superiority of their educational methods, it is probably because the power to teach is a rare art, but little cultivated as an art, so that the demand for able teachers is likely always to be altogether beyond the possible supply. And hence it results that young girls rarely have the benefit of the best teaching. But the consequence of this is that in most cases the early impressions remain, derived from teachers who are mere knowledge-mills rather than educators, and the mind is moulded into a type which it will retain, before the unfortunate pupil receives the veneer or fringe of educational training which parents usually desire as a covering to a dry store of unorganized knowledge. Even in the garden of education we do not gather grapes of thorns;

and are not likely to find brilliant, productive intellectual energy among women until they prefer to eat of the tree of education rather than of the tree of knowledge, and acquire the taste early in life. Another striking feature in the education of women is the comparative immunity which it has enjoyed from examinations. This may be a consequence in part of the prizes of life which examinations govern not being open to women; but it is also in part a recognition by parents that examinations are no test of education, and only a test of some forms of knowledge. Examinations are, above all, a test of physical endurance, the extreme capacity of which the world rarely demands, which is too valuable to risk straining to the utmost while the physical frame is immature, and the faculties are unfolding.

In the coming years the whole future of education is likely to depend upon the attitude which women take with regard to it. Now that disabilities are being removed in universities, nothing could be more natural and laudable than that women should aspire to receive the highest literary recognition which can be given. But in this seeking after degrees they abandon the distinctive line of education traditional in their sex, and become imitative of men, with no adequate advantage beyond a demonstration that tests for knowledge offer no difficulties to them. In thus gaining an outward symbol of knowledge they may deprive the cause of education of their influence. And in becoming graduates they are not unlikely to throw in their sympathies with the old educational system, which exists because there has been perpetual succession in the inheritance, and because universities supply schools with masters, who in return send their more robust scholars to the universities.

Women, however, may reasonably demand a reconsideration of the educational system of the country, in which there shall be some adequate relation established between the training of youth and the activities of mature life, not only for themselves, but for their children. And then a time may come when scholarships, fellowships, and such-like allurements of money and honour for the chosen of the gods, will cease to be regarded as an adequate set-off for exhausted nervous energy in the unchosen many, in which the fires of youthful health, originality, and independence are quenched. These honours are as much prizes in a lottery, as the prizes in lotteries which the wisdom of the State suppressed long ago. We may fairly question whether the educational results which have followed these awards justify the use made of national and corporate funds. The award of a scholarship supposes that university education is costly. As a fact, the fees are moderate, if not small. But if the scholarships were utilized to render university education free by adequately endowing professorships and lectureships, then a far greater impetus would be given to higher education than is possible under the present system, when the lecturers, at least, can only afford to teach publicly because they are not entirely dependent upon the remuneration which the university and the colleges offer. The endowment of professorships is one of the greatest educational needs of the country. We would not ask that professorships should be as numerous as rectories, or desire that educational chiefs should be remunerated on the same scale as bishops; but we may claim that the aggregate secular knowledge of mankind is becoming the basis upon which the religious teacher has to carry out his educational work. And hence the need for an organization of professorial teaching which shall cause the country to become permeated with the best knowledge, thought, educational results, and methods of research.

So long as primary education was left to the voluntary system, we know that multitudes obtained no teaching at all. But by the school-board system, dependent upon local rates, funds have been found for the maintenance of buildings and payment of teachers. Now all the resources of the ancient colleges are no more than are wanted for teaching students of the universities which the colleges form, and we cannot expect such funds to meet the needs of the entire country. But if people, who know how the prosperity of the country depends upon education, were disposed to give their convictions practical effect, there would be no difficulty in raising, by means of a modified action of the Public Libraries Act, funds which should be adequate for the higher education of every township or electoral district. The universities are becoming decentralized, and colleges, endowed in recent times by the munificence of heroic men, have commenced to educate the energies of the people in a few towns in the north of England; but we can never expect to see a sufficient number of colleges endowed in all parts of the country by such means. There must be self-help. And to meet the necessities of the busy adult population, there is probably no means of education which can compare in usefulness of method with that known as the King's College Lectures for the People, and the University Extension System, which is yet capable of great development on the practical side. Now, this method, which in some important elements of education carries teaching to pupils who would never go to a university, only requires to be permanently established in each administrative district, to work the greatest and most beneficent revolution in English education which has ever occurred. Hitherto those lectures have not always been a financial success, but, with organization of a free library as a foundation, and an endowment fund raised by a voluntary local rate, their prosperity would be independent of fees; they should offer the best teaching, if not gratuitously, at a nominal fee, to all comers, and be able to ensure a succession of subjects taught which would result in courses of study not quite incomparable in educational results to a university curriculum. The King's College Lectures for the People, like the University

Extension System, has the social advantage that it does not separate men from women, or the young from the mature; it does not necessitate the slightest strain on body or mind, but brings the stimulating influence of exact methods and new knowledge to those whose lives for the most part are already advancing in the paths of productive activity.

This organization of university education is more important than appears at first sight; for, quite irrespective of the personal happiness which it tends to diffuse, it is creating a force of enlightened public opinion which sooner or later will exert itself as an influence in bringing the subjects studied in public and other schools into better harmony with the conditions of English life. And by diffusion of knowledge of the English language, of history, of political economy, and science, by methods which tend to develop the moral faculties, its influence in commerce and politics may well be incalculable. It may change the principles of many industries. Science has been utilized in all manufactures, but sometimes to the deterioration of the quality of the product, which is sold at a lower price, but yields a larger profit. At present the mass of the people are too unfamiliar with the histories of industries to appreciate the way in which a deterioration in manufacturing methods affects the circulation of wealth by enriching the few who use the new discoveries, at the expense of the many who buy the less durable article; and, ultimately, in discrediting certain industries, so as to bring about commercial depression. But, as people become more familiar with the nature of the products which they buy or use, a regulating influence of public opinion may be able to ensure a less speculative basis for such traders. And in politics we can only point to the circumstance that the majority of the most highly educated men, as represented by our older universities, are Conservatives, while the majority of the least educated are everywhere Radicals, as rendering it highly probable that increased knowledge and education thus diffused will exercise an influence in withdrawing attention from abstract principles, to political ideas which grow out of antecedent circumstances, and which the nation is prepared to adopt.

Under such conditions as I have sketched education goes on, with hopes which come fresh with the rising sun and succeeding years. But at last man's physical strength matures, and begins to wane; and then succeeds the epoch of greatest intellectual effort. Education, in its main outlines, is complete, so far as its method is concerned ; and it only remains for us to apply, each in his own way, what we have gained in the building up of our life's achievement. But at last that work is done ; and its results, whether humble and unregarded, or conspicuous and honoured, merge in the common stock which makes up the unearned inheritance of civilized man. This inheritance of all that men have been able to preserve, or have been incapable of destroying of the labours of mankind, has furnished us with the plans, successes, and failures of other men's lives ; the inheritance of nature has yielded materials and forces with which our own activities have to be exerted. And whether these vast possessions seem to us much or little, depends mainly upon the uses that we have learned to make of them by our education.

I have said nothing of the place of religion in education, because religion does not always signify the same conceptions to all people, and because religion is so personal a possession that it is difficult to say anything upon it of a general nature which would make our idea of education clearer. But since I have considered education from the beginning of life, to its close, I may say that there are hopes which cluster round life and death, and are the special province of religion, which exercise more or less weighty influence on all education. The religious feeling is partly an inherited character of the race, and partly the product of education. But unless it permeates or saturates life, so that every act and endeavour of existence has a basis which unites them into one sustained movement onward towards higher things, I should not express what I conceive the religious side of life's education to be. To the religious nature neither life nor death has terrors, and in freeing existence from its greater anxieties the influence of religion works on the same foundation of moral effort as science. The sciences are the sisters of religion in that they unfold something of the laws by which the universe is governed, and by which man's life is directed. They are thus far the stepping-stones of faith. And those who have learned that health is the reward which man may gain by moral discipline, that mental vigour may be augmented by the wise (or moral) use of food, and that education is the systematic exercise of moral responsibility in any or all of the affairs of life, may find that in the practice and pursuit of the truths of science they are conscious of a religious education which is a light to the feet. Such matters are factors in life, which may educate us in a reverent appreciation of religious truth and divine government of the world.

THE END.

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